Review of the 1997 and 1998 Pilot Commercial Fisheries for Neon Flying Squid *(Ommastrephes bartrami)* off the West Coast of Canada

S. Campagna, G.E. Gillespie, and W. Shaw

Fisheries and Oceans Canada
Science Branch, Pacific Region
Pacific Biological Station
Nanaimo, British Columbia
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REVIEW OF THE 1997 AND 1998 PILOT COMMERCIAL FISHERIES FOR NEON FLYING SQUID (*Ommastrephes bartrami*) OFF THE WEST COAST OF CANADA

By

S. Campagna, G.E. Gillespie, and W. Shaw[1]

Fisheries and Oceans Canada

Science Branch, Pacific Region

Pacific Biological Station

Nanaimo, British Columbia

V9R 5K6

[1] Fisheries and Oceans Canada

Fish Management Branch, Pacific Region

3225 Stephenson Point Road

Nanaimo, British Columbia

V9T 1K3

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ABSTRACT

Campagna, S., G.E. Gillespie, and W. Shaw. 2000. Review of the 1997 and 1998 pilot commercial fisheries for neon flying squid (*Ommastrephes bartrami*) off the west coast of Canada. Can. Ind. Rep. Fish. Aquat. Sci. 256: 74 p.

The three-year pilot commercial fishery using automated jigging machines for neon flying squid (*Ommastrephes bartrami*) off the west coast of Canada, initiated in 1996, was continued in 1997 and 1998. The pilot fishery program is expected to continue from 1999 to 2001.

This report details catch, effort, CPUE, location and oceanographic data collected by the fishers through a harvest logbook program. Biological data gathered by observers is summarized. The report also documents management plans and roles of government and private agencies in the fishery.

A total of 494 neon flying squid, weighing 1,258 kg, were landed in 1997. Four vessels reported 20 operations totalling 116 hours of fishing, which represented 32,519 jig-hr of effort. CPUE ranged from 0 squid/jig-hr to 0.101 squid/jig-hr (0.257 kg/jig-hr), with an overall mean of 0.015 squid/jig-hr (0.039 kg/jig-hr) for the 1997 fishery.

A total of 28,023 neon flying squid, weighing 63,032 kg, were landed in 1998. Four vessels reported 91 operations totalling 1,072 hours, which represented 67,315 jig-hours of effort. CPUE ranged from 0 squid/jig-hr to 2.667 squid/jig-hr (6.498 kg/jig-hr), with an overall mean of 0.416 squid/jig-hr (0.936 kg/jig-hr) for the 1998 fishery.

Neither catch nor CPUE exhibited relationships with effort or temperature. Bycatch in the fishery was limited to other squid species, pomfret, mackerel and blue shark. Results of biological sampling are presented. Results from these fisheries are compared to those of the 1996 pilot commercial fishery and a joint Canadian-Japanese jig fishery conducted in 1990-91.

RÉSUMÉ

Campagna, S., G.E. Gillespie, and W. Shaw. 2000. Review of the 1997 and 1998 pilot commercial fisheries for neon flying squid (*Ommastrephes bartrami*) off the west coast of Canada. Can. Ind. Rep. Fish. Aquat. Sci. 256: 74 p.

Le projet pilote de trois ans de pêche commerciale de l'encornet volant (*Ommastrephes bartrami*) à la turlutte automatique, sur la côte ouest du Canada, a été lancé en 1996 et a continué en 1997 et 1998. Ce projet pilote devrait se poursuivre de 1999 à 2001.

On trouvera dans le présent rapport des détails sur les captures, l'effort, l'indice CPUE, les lieux de pêche et les données océanographiques recueillies par les pêcheurs grâce à un programme de journaux de pêche. Les données biologiques recueillies par les observateurs sont également résumées. Le document présente les plans de gestion et les rôles respectifs des agences gouvernementales et des organismes privés.

Au total, 494 encornets volants, pesant 1 258 kg, ont été débarqués en 1997. Quatre bateaux ont déclaré avoir réalisé 20 campagnes totalisant 116 heures de pêche, ce qui représentait un effort de 32 519 heures-turlutte (h-t). L'indice CPUE allait de 0 encornet/h-t à 0,101 encornet/h-t (0,257 kg/h-t), soit une moyenne globale de 0,015 encornet/h-t (0,039 kg/h-t) pour la pêche de 1997.

Au total, 28 023 encornets volants, pesant 63 032 kg, ont été débarqués en 1998. Quatre bateaux ont déclaré avoir réalisé 91 campagnes totalisant 1 072 heures, ce qui représentait un effort de 67 315 heures-turlutte. L'indice CPUE allait de 0 encornet/h-t à 2,667 encornet/h-t (6,498 kg/h-t), soit une moyenne globale de 0,416 encornet/h-t (0,936 kg/h-t) pour la pêche de 1998.

On n'a relevé aucun lien entre les captures ou l'indice CPUE et l'effort ou la température. Les prises accessoires de cette pêche étaient limitées à d'autres espèces de calmars, à la castagnole, au maquereau et au requin bleu. Nous présentons les résultats de l'échantillonnage biologique. Les résultats de cette pêche sont comparés à ceux de la pêche commerciale pilote de 1996 et d'une campagne canado-japonaise de pêche à la turlutte menée en 1990-1991.

INTRODUCTION

BACKGROUND

Neon flying squid (*Ommastrephes bartrami)* (Table 1) are found throughout the North Pacific Ocean to approximately 50°N latitude (Roper *et al.* 1984; Murata and Hayase 1993). Flying squid migrate northward in the spring and summer to feed, and return south (21-35°N) to spawn after September. The population is believed to be composed of two sub-populations; a spring-breeding group and a fall-breeding group. Spring-breeding squid migrate northwards during the spring and early summer. Females move northward more quickly than males. Southward migration takes place in October-November for males and November-December for females. Fall-breeding squid remain in subtropical waters from the time they hatch (late summer-fall) until the following spring, and migrate north in the summer and fall. Fall-breeding males do not migrate as far north as females, and begin their southward migration in July, while females migrate south after September. Because squid from the fall-breeding cohort have grown over the winter months prior to their northward migration, these are referred to as the "large" cohort, while the younger spring-breeding cohort are the "small" cohort.

Flying squid are extensively fished in the North Pacific, and were the target species of the large-scale driftnet fisheries carried out by Japan, Korea and Taiwan until pelagic driftnet fishing was banned by the United Nations General Assembly after 1992 (Gillespie 1997). Experimental fisheries between 1979 and 1987 using drifting gillnets (Bernard 1980, 1981; Robinson and Jamieson 1984; Sloan 1984, 1991; Jamieson and Heritage 1987, 1988) and between 1979 and 1991 using jigging machines (Sloan 1991; Shaw and Smith 1995) indicated that neon flying squid were available at commercially viable abundance within the Canadian 200-mile Fisheries Conservation Zone (FCZ) in the summer and fall.

In 1996 an exploratory commercial jig fishery for neon flying squid was initiated via industry/government partnerships. The potential for developing this as a pilot new fishery was addressed by Department of Fisheries and Oceans (DFO) and the British Columbia Ministry of Agriculture, Fisheries, and Food (MAFF) via the signing of a Memorandum of Understanding (MOU) on Fisheries and Seafood Diversification on December 6, 1995. The objective of this MOU was to provide an orderly, precautionary approach to new commercial fishing opportunities in British Columbia. A Federal/Provincial committee was formed under the auspices of the MOU and developed operational guidelines for the implementation of this pilot fishery.

The purpose of the exploratory fishery for neon flying squid was to determine the feasibility of an automatic jig fishery. In particular, the fishery needed to determine the distribution and abundance of this species within and adjacent to Canada's FCZ, assess the effectiveness of the automatic jig technology for harvesting large squid, and collect fishery assessment and bycatch information to support sound fisheries management decisions. This exploratory fishery proceeded from 1996 to 1998. The three-year period would provide the necessary time to gain some understanding of the resource and determine whether this would be a viable fishery.

During the pilot fishery a precautionary total allowable catch (TAC) of 1,500 t was set for neon flying squid. This arbitrary annual TAC was calculated by multiplying preliminary Japanese jig fishery production (~100 kg/machine-day) by a maximum of 200 machines in the Canadian fishery and 75 fishing days per season. The Japanese driftnet fishery removed ~168,000 t of flying squid per year between 1981-1990 (Yatsu *et al.* 1993) and all-nations driftnet and jig catches varied between 200,000-300,000 t annually during this period (Gong *et al.* 1993). The 1,500 t TAC represents 0.50-0.75% of the long-term catch range for the northern Pacific. This was considered a precautionary level of catch relative to past production.

In 1996, other squid species, pomfret and blue shark were limited by a bycatch ceiling of 2% of the landed weight of flying squid per trip. In 1997 and 1998 a TAC of 75 t was set for each of the following species: boreal clubhook (nail) squid (*Onychoteuthis borealijaponica*), boreopacific gonate (eight-armed) squid (*Gonatopsis borealis*), and schoolmaster gonate (red) squid (*Berryteuthis magister*). These species will be referred to using the common names in brackets rather than the FAO names.

The pilot fishery is expected to continue from 1999 to 2001, as there are currently no conservation issues, and fishers are gaining a better understanding of how to successfully fish neon flying squid.

SQUID JIG FISHING

Modern squid jig fishing requires sophisticated automated jigging machines and high-powered light arrays, either mounted in the vessels' rigging, or deployed underwater. The jigging machines have either one or two spools of line, depending on the model. Each line is rigged with a large weight at the end of the line, and a series of plastic jigs armed with rosettes of hooks, usually spaced about 1 m apart. The number of jigs per line generally varies between 5 and 30. A jig-cycle begins when the machine deploys the line to a pre-set depth, then retrieves it in graduated steps to another pre-set depth, finally rewinding the line to the surface. As the jigs are retrieved over a roller at the rail of the boat, the line angle changes, inverting the jigs and allowing captured squid to fall into collecting troughs which lead to a central processing area. Another jig-cycle commences when the line is re-deployed.

All vessels have multiple machines which may be operated independently or co-ordinated through a computer terminal located in the wheelhouse. Computer co-ordination reduces the occurrence of tangled lines and attempts to ensure continuous fishing with at least one line fishing at any time.

The light arrays are used to attract shoals of squid to the boat. During night-time operations, the overhead light array is used to concentrate squid at the surface. Recently, the use of underwater lights to attract squid at depth has been used in both night-time and daytime operations. Fishing occurs at 250-350 m depths during daytime operations and generally less than 200 m depths during night-time operations.

A fishing operation commences when a sea anchor and rudder sail are set to stabilize the vessel, and one or more machines are activated. The operation ends when continuous fishing ceases either for the day or to move to another fishing location.

When vessels were seeking to fish outside of the FCZ, they undertook trips of several weeks. In recent years, vessels have made trips of two to three weeks duration within the FCZ, beginning in July. In 1997 and 1998, some trips were made in May and June to explore availability of red and nail squid during the time period that neon flying squid are not available in the FCZ.

DFO MANAGEMENT ACTIVITIES

Activities of DFO Operations Branch staff for the 1997 and 1998 fisheries included updating management plans, reviewing licence applications, selecting participants approved for licence, issuing licences, and developing a collaborative agreement with the industry partner (Eastern Pacific Squid, Inc. [EPSI]) in support of observer coverage, landings validation and recovery of management and assessment costs.

DFO STOCK ASSESSMENT ACTIVITIES

Stock Assessment Division staff activities for the 1997 and 1998 flying squid fisheries included developing a new harvest log format for 1997, analysing harvest log and observer data and summarizing biological characteristics of the catch. A phase 0 review (*fide* Perry *et al.* 1999) of the biology of oceanic squids and squid assessment and management frameworks (Gillespie 1997) and a review of the 1996 pilot fishery (Gillespie and Shaw 1997) were completed.

METHODS

MANAGEMENT PLAN

Fisheries management plans were updated prior to each season, in consultation with industry (Appendix 1). The Total Allowable Catch (TAC) was set at 1,500 tonnes and the maximum number of automatic jig machines allowed in the fishery was limited to 200. Two licenses were required in order to fish: a licence for experimental, scientific, educational, or public display purposes ("scientific licence") and a licence to fish or trans-ship fish in waters other than Canadian fishing waters ("high seas licence"). The latter was only required if fishers wished to fish outside the Canadian FCZ. Harvest logbooks, an observer program and validation of landings at designated landing ports were requirements of licence. A diligent-use clause (minimum of 1 percent of the total reported landings in round weight, or 10,000 pounds landed

prior to the end of the pilot fishery) was included in the plan to ensure that people would use their licence.

COLLABORATIVE AGREEMENT

The neon flying squid fishery is one of several identified under the federal-provincial MOU. DFO advised all potential participants that development and implementation of this fishery is to be cost neutral to the Department. On July 25, 1996 a collaborative agreement was made between the Minister of Fisheries and Oceans Canada and the Eastern Pacific Squid Incorporated (EPSI). The collaborative agreement between fishers and DFO benefits both the fishers and DFO by allowing this experimental fishery to proceed and offering parties opportunities to develop this fishery. DFO and EPSI undertook a joint program from July 25, 1996 to December 31, 1998, to initiate and manage an experimental fishery for neon flying squid both in and outside the FCZ. As a result, EPSI provided DFO with the necessary funding required to develop, initiate and undertake the proper management and control of this new fishery. In addition, the agreement provided DFO opportunities to assess the progress of the fishery and to interpret and report on data collected in-season.

SELECTION OF PARTICIPANTS

In order to select eligible vessels, the joint DFO/MAFF Seafood Diversification Committee applied the following criteria:

1. The vessel is licensed to fish in west coast Canadian waters (*i.e.*, has Schedule II licence privileges) and has minimum vessel at-sea endurance of two weeks (as measured by the vessel's fuel capacity);
2. The vessel possesses a 100 kHz (minimum) echo sounder;
3. The vessels possesses instrumentation for sea surface temperature monitoring and recording;
4. The vessel has on-board freezing capability to freeze to a core temperature of -5° F within 3 hours with a thermal arrest period of no longer than two hours, and a holding capacity of 25,000 pounds;
5. The vessel has a 50 kilowatt (minimum) generator;
6. The vessel has suitable accommodation and workspace for a DFO certified observer;
7. The vessel has sufficient space to install and operate a minimum of four automatic jigging machines (a plan, to scale, of the vessel's deck layout with the jigging machines is required with the application);
8. The vessel and crew must comply with private insurance standards for fishing offshore waters; and
9. Written confirmation of commitment from a buyer to purchase or market neon flying squid (not in the Conditions for Entry, but a criteria specified on the licence form).

To obtain licenses, each eligible party had to provide confirmation from MAFF that at least four automatic jigging machines had been obtained (or had been purchased and were awaiting delivery). The scientific permit and licence was renewed for 1997 and 1998 if:

1. All conditions of the licence and any collaborative agreement were met.
2. Diligent use was made of the licence (minimum annual criteria were set in consultation with the licence holders).
3. All required fees were paid.

HARVEST LOGS

Information Requirements and Format

Fishers were required to complete and submit harvest logs as a condition of licence. Harvest logs provided information regarding gear configuration of the vessels participating in the fishery, catches and details of the effort levels which produced these catches (Appendix 1). In 1997, the harvest log was separated into two forms: a Vessel Configuration Form and a Harvest Log form. The forms used in the fishery differed slightly from those included in the management plan.

The Vessel Configuration Form (Appendix 1) provided basic identification and configuration information for the fishing vessel. This form is divided into a header (year, vessel and skipper's names, CFV number and configuration number), sections describing jig machines (make, model, code, number of machines, spools/machine); lights (bulb wattage, colour, type and number of bulbs); standard fishing configuration (wheelhouse jig computer, sounder type, satcom and cellular telephone); and comments.

The harvest log portion recorded operation-specific information. An operation is defined as the time period between the commencement of fishing and the cessation of fishing activities. Fishers were instructed to report the end of an operation whether fishing activities were finished for the day or the vessel ceased fishing for a short period to move to a new position. Thus, it is a continuous period of fishing, regardless of how many machines might be in operation. This form was divided into a header (year, vessel, skipper's name, CFV number, set number, biological sample) and sections providing information on the fishing operation (month, day, time, latitude, longitude, sea surface temperature, moon phase, % overcast and wind speed information at the initiation and completion of each operation); set configuration (number of lines fished, number of jigs per line, spacing of the jigs, haul rate and minimum and maximum depths fished); landings (catches of flying squid, other squid and other species in number and weight); and comments.

Information recorded on the completed log sheets was proofed and coded, and entered into the DFO Shellfish Harvest Log database maintained by Stock Assessment Division, Pacific Biological Station.

Missing Values

Many log entries were incomplete. When information regarding the duration of the operation was missing, the average operation duration for the trip was used in the analyses. Missing values for gear configurations (number of lines and number of jigs per line) were taken from the nearest complete records. Missing squid numbers were estimated from the logbook weights, using a mean weight. Missing logbook weights were estimated based on the number of squid times a mean weight.

Catch Weights

In many cases, catch was reported as only as number of squid, and did not include the estimated total weight of squid per operation. The estimated weight of catch was determined by partitioning the total verified landing, converted to whole round weight (see below), into each operation according to the proportion of the total reported catch in numbers:

$$C_i = \sum_{i=1}^{N} C_i \left(\frac{n_i}{\sum_{i=1}^{N} n_i} \right) \qquad (1)$$

where C_i = the estimated whole weight of squid captured in operation i, $\sum_{i=1}^{N} C_i$ = the verified landing weight for the trip, n_i = the number of squid captured in operation i, $\sum_{i=1}^{N} n_i$ = the total number of squid captured on the trip and N = the total number of operations in a trip. For example, if a vessel reported a total of 100 squid captured, and took 10 of them in a given operation, the catch weight for that operation would be 0.10 of the total verified catch weight converted to whole round weight.

When vessels did not validate landings, estimated weight from the harvest log was used. In some cases, this had to be estimated from the number of squid caught, multiplied by a mean weight derived from biological samples taken by the observer. Conversely, when only weights were available, the number of animals was estimated using a mean weight.

CPUE

Catch-per-unit-effort (CPUE) was calculated for each operation as the number of squid captured in an operation per jig-hour (E_i):

$$CPUE_i = \left(\frac{n_i}{j_i * h_i} \right) \quad (2)$$

where n_i = number of squid captured in operation i, j_i = number of jigs used in operation i, and h_i = duration of operation i in hours. Similarly, CPUE based on estimated weight of squid captured in an operation was:

$$CPUE_i = \left(\frac{WRW_i}{j_i * h_i} \right) \quad (3)$$

where WRW_i = the estimated whole round weight of squid captured in operation i measured in kg.

The overall weighted mean annual CPUE was calculated as:

$$\overline{CPUE} = \sum_{i=1}^{N} (W_i * CPUE_i) \quad (4)$$

where $W_i = E_i/E_T$. W_i is the relative statistical weight of effort in operation i (E_i) to the total effort from all operations in a year (E_T).

OBSERVER COVERAGE

Observer coverage was provided through an industry agreement in 1997 and through a co-management agreement between industry and DFO in 1998. DFO required that one observer attend the fishery at all times, as well as could be arranged considering the few participating vessels, long duration of trips, and short season.

Observers were used to gather detailed catch and effort information and biological samples from the fishery. Observers monitored (in greater detail than was required by harvest logs) specific gear configurations for the development of standardized estimates of CPUE; determined conversion factors to estimate whole round weight from verified product weights (squid are processed at sea and landed as frozen blocks of specific products, *e.g.*, mantles, fins, tentacles, *etc.*); collected length, weight, sex and maturity data from the catch; determined drop-off rates (where squid are observed to fall off jigs before they can be landed or only arms or tentacles are retained on jigs); and monitored bycatch of other species.

Catch Monitoring

Observers were instructed to observe and record the fishing success of a portion of the gear (one or two machines) for which gear configurations had been documented in detail. Information included number and arrangement of jigs, start and finish locations, sea surface

temperature, depths fished, haul rates, and oceanographic and weather conditions. Total catch (numbers and weight) of all squid and other species were recorded. Because information recorded in harvest logs are a summary of average number of machines operating and number of jigs per line during the operation, observer data provide more details than logbook summaries of entire operations.

Drop-offs

The term "drop-off" is used to describe the loss of a hooked squid, observed either above the water surface (when the mass of the squid causes the jig to tear out of the body or break off the hooked arm or tentacle), or inferred to have happened underwater by the presence of detached tentacles or arms on a retrieved jig. Observers estimated drop-off rates during a few operations by periodically monitoring individual lines as they were retrieved. Sea state (Beaufort Scale) was recorded for each observation period. The drop-off rate per jig cycle was calculated as:

$$\%Dropoff_j = \frac{(D+T)}{(S+D+T)} * 100 \qquad (5)$$

where S is the number of squid brought on board, D the number of squid dropping above the water and T the number of jigs with only tentacles or arms coming at the surface during a jig cycle. The percentages obtained were then averaged to obtain a mean drop off rate per operation.

Product Conversion Factors

Product conversion factors were calculated and used to estimate catch from verified landing weights of products, independent of logbook estimates. Shaw and Smith (1995) calculated conversion factors for several product types resulting from on-board processing of flying squid in the 1990-91 experimental fisheries. Additional product types were recorded in 1996 (mixed products) and 1998 (wings, mantles without fins and skinned mantles without fins) (Table 2).

Observers collected data to develop conversion factors to estimate whole round weight of the catch from weights of processed products. Observers measured processed product weights from individually weighed and measured squid. Product recovery rates (RR) were calculated as:

$$RR = \left(\frac{PW}{WRW} \right) \qquad (6)$$

where PW = product weight and WRW = whole round weight. Conversion factors (CF) are simply the inverse of the recovery rate:

$$CF = \left(\frac{1}{RR}\right) = \left(\frac{WRW}{PW}\right). \quad (7)$$

Biological Samples

Representative samples of the catch were measured for dorsal mantle length (DML) and whole round weight. In most cases, the entire catch from an operation could be processed, but when catch rates were high, a subsample of the catch (usually the entire catch for a given time period) was processed. Information regarding the sex and reproductive maturity state of the animals (subjectively for males and through measurement of nidamental gland lengths (NGL) for females) were taken at the same time. Female maturity states were those defined by Durward *et al.* (1979) for *Illex illecebrosus* (Table 3).

Length frequencies were plotted and mean DML and weight of animals in the sample calculated. An exponential relationship between individual DML and round weight was fit for each sample using the equation:

$$WRW = a(DML)^b \quad (8)$$

where WRW = whole round weight measured in g and DML = dorsal mantle length measured in cm.

VERIFICATION OF LANDINGS

Landings were verified at point of delivery by a third-party contractor. Vessels hailed in prior to landing, and date and location of landing, vessel identification and landed weights by product type were recorded during offloading by the verifier.

Derivation of Whole Round Weight

Total verified product weights were multiplied by the appropriate conversion factor (CF) to estimate whole round weight of the catch. Weights of mantles or tubes were used when available and product types accounting for the largest proportion of whole weight were used if mantles or tubes were not packed separately. All estimated whole round weights were reduced by 4% in 1997 and by 2.5% in 1998 to account for glazing of the products, based on pre- and post-glazed block weights recorded at sea by observers.

RESULTS

A total of 21 vessels qualified for licences in both 1997 and 1998. Only four vessels participated in the fishery each year, three of which participated in both years. All participating vessels submitted logbooks. Levels of effort and landings were disappointingly low in 1997; one vessel validated landings, two vessels reported landings on harvest logs but did not validate landings, and the remaining vessel reported no catch. In 1998, three vessels validated landings, and the remaining vessel submitted an offload tally sheet.

One observer trip was completed in 1997, however, limited effort and poor catch rates resulted in no opportunities to collect information. One observer trip report was completed during the 1998 season (AMR 1998).

CATCH

Neon flying squid

Total catch reported in logbooks in 1997 was 494 flying squid, with an estimated total round weight of 1,258 kg (Table 4). The best available estimate of total weight was a combination of the verified landings of the vessel that validated its catch and the logbook estimates of the vessels that reported catch but did not verify landings. Total catch inside the Canadian FCZ was 394 flying squid (1,004 kg) and from outside was 100 squid (254 kg).

In 1998, total catch reported in logbooks 28,023 flying squid, with an estimated total round weight of 63,032 kg (Table 4). Total catch inside the Canadian FCZ was 27,800 squid (62,561 kg), and from outside the FCZ was 223 squid (471 kg).

In most cases, logbooks recorded only numbers of squid captured, not weights. In instances where weights were estimated, there was poor agreement when these estimates were compared to verified landings.

Other target species

In 1997, the most abundant other target squid species caught was nail squid, with 26 squid reported (Table 4). In 1998, 23 eight-armed squid represented the most abundant squid catch other than flying squid. Nine red squid were reported in 1997, but at least 4 of these were dipnetted at the surface.

Bycatch

Two robust clubhook squid were reported in 1998. Two species of fish were reported in both years: Pacific pomfret (3 in 1997 and 6 in 1998) and blue shark (2 in 1997 and 11 in 1998). These sharks were only occasionally taken by jigging machines, more often they were fished with baited handlines to remove them from the vicinity of the vessel before they fouled the jigging lines. One mackerel, not identified to species, was reported as bycatch in 1997.

EFFORT

The fishery was open from May 12 to December 31, a total of 234 fishing days in 1997. Four vessels participated in the fishery between May 7 (first reported fishing date) and September 20 (last reported fishing date). A total of 20 operations were reported on logs, which totalled 116 clock hours and 32,519 jig-hours. The average duration of an operation was 5.81 hours and daytime operations were rare (one daytime operation reported did not produce catch).

In 1998, the fishing season was open from August 1 to December 31, for a total of 153 fishing days. Four vessels participated in the fishery between July 11 (first reported fishing date) and September 27 (last reported fishing date). A total of 91 operations were reported on logbooks, which totalled 1,072 clock hours and 67,315 jig-hours. Average duration of an operation was 11.78 hours, and 16 daytime operations were reported in 1998.

In 1998, fishers departed from the traditional practice of fishing primarily at night, and began using underwater lights to aggregate squid at depth, and fish during the day. Several of the participating vessels fished continuously for a number of days, making either a single logbook entry for the entire operation, or daily entries. In either case, we were not able to assign catch or effort to day or night operation categories. Fishers reduced, on average, the number of machines that were operated during an operation and also reduced the number of jigs rigged per line. Because of the depths fished during daytime operations, decreasing the number of machines in operation reduced time lost to tangling of the jigging lines.

CPUE

Mean CPUE for the fleet was 0.015 squid /jig-hr (0.039 kg/jig-hr) in 1997. The highest single operation CPUE reported in logbooks was 0.101 squid/jig-hr (0.257 kg/jig-hr). The highest monthly average CPUE was 0.155 kg/jig-hr, reported in July, fishing inside the FCZ Table 5). The relatively small number of operations and generally low CPUE make relationships of catch to positional information, temperature or level of effort meaningless (Figures. 1, 3-5; upper panels).

In 1998, mean CPUE for the fleet was 0.416 squid /jig-hr (0.936 kg/jig-hr). The highest single operation CPUE reported in logbooks was 2.667 squid/jig-hr (6.498 kg/jig-hr). CPUE did not exhibit latitudinal or longitudinal trends (Figure 2). Numerous unsuccessful operations

surrounded the greatest levels of CPUE, all in the geographic area of greatest effort. Squid catches were recorded at sea surface temperatures between 12.8 and 16.6°C, with the highest values near 16 °C (Figure 3; lower panel). Although the total catches generally increased with effort (Figure 4; lower panel), there was no relationship between CPUE and effort level (Figure 5; lower panel). This reflects the tendency of fishers to expend more effort in instances where some success has been experienced.

The success of jigging operations was affected by the presence of blue sharks. The sharks were reported to catch hooked squid and tangle the lines as they swam away, occasionally breaking them. The time required to untangle the lines, and the lost squid, were not accounted for in reported effort or landings.

DROP-OFFS

The overall mean drop-off rate was 53 %, calculated over eight operations in 1998. Drop-off rate was not correlated to sea state. In rough weather, is possible that there is a greater frequency of escapes where no squid parts remain on the jig, which may mean that drop-off rates were underestimated. Conversely, it is not clear whether tentacles may have been retained on the jig through more than one cycle; thus an *ad hoc* observation might represent drop-offs from several cycles, but only the catch of the observed cycle, overestimating drop-off rates. These estimates were higher than, but comparable to, those found during a Japanese jigging operation (Inada *et al.* 1995).

BIOLOGICAL CHARACTERISTICS

Biological samples were processed on one observer trip only in 1998. A total of 822 squid were measured for dorsal mantle length (DML) and 183 for whole round weight. Sampling for round weight was not conducted after the observer developed the length weight regression in August. Squid were not sampled for sex during the first phase of the trip. A total of 724 squid were sampled for sex, these consisted of 15 males, all caught in August, and 709 females.

Length and Weight

In 1998, squid size increased during the summer. DML of squid sampled ranged from 30 to 52 cm in July, 32 to 53 in August, and 33 to 54 in September, with mean DMLs of 37.9, 39.8 and 44.1 cm, respectively (Table 6). Dominant modes in the length frequency distribution appeared at approximately 35 cm in July, 39 cm in August and 45 cm in September (Figure 6).

Mean weight also increased during the summe a though samples were only taken during July and August. Whole round weight of squid sampled ranged from 1.1 to 4.1 kg, in July and 1.4 to 4.9 kg in August, with mean weights of 2.0 and 2.2 kg respectively. In both months, most squid weighed were between 1-2 kg (Figure 7).

Length-weight relationships were calculated separately for July 1998 and August 1998 samples. Regressions showed a reasonable fit to the data, with r^2 values of 0.876 and of 0.867 for July and August, respectively (Figure 8). While the relationships describe the available data fairly well, there are no data for smaller squid. This may be due to gear selectivity, but more likely because small flying squid are not available in B.C. The observer did not record weights in late August or September 1998.

Maturity

Maturity stages from biological samples were recorded between August 6 and September 25, 1998. Observations indicated that most females were in stage 2 and 3 (Figure 9). There was evidence of females maturing through the summer, as indicated by a decrease in the percentage frequency of females in stage 1 and increases in percent frequency of females in stages 2-4.

PRODUCT CONVERSION FACTORS

Product conversion factors were calculated during the observer trip. The vessel packed mantles (without fins), skinned mantles (without fins), fins, tentacles and mixed products. Recovery rates calculated in 1998 were 41.4% for mantles (n = 183), 37.1% for skinned mantles (n=34), 19.5% for tentacles and arms (n = 89), and 11.1% for wings (n = 88) (Table 8). The observer stopped taking the measurements when he felt he had a reasonable estimate of component recoveries, although average squid size changed during the season.

DISCUSSION

As observed in previous experimental fisheries, catches and catch rates vary widely between and within years (Shaw and Smith 1995; Gillespie and Shaw 1997). The 1997 catch was the lowest reported since experimental jig fishing was begun in 1990 (Table 9), primarily because limited success early in the season discouraged further fishing effort. Mean monthly CPUEs from the 1997 fishery were generally higher than 1996, with the exception of August and September inside the FCZ (Table 5). However, these estimates are based primarily on logbook data (60% of records were not linked to verified landings), as only one vessel landed enough product to warrant verification in 1997. Comparison of logbook weight and verified landings converted to whole weight (Table 4; Gillespie and Shaw 1997) show poor correlation.

The 1998 season was much more productive. The total catch was the highest reported in experimental fisheries since 1990, when five Japanese vessels conducted experimental fishing off the B.C. coast (Table 9; Shaw and Smith 1995). Mean monthly CPUE was higher, in all months, than any CPUE reported in previous fisheries. Some vessels participated in all three years of the pilot fishery, and it is possible that fishing experience caused the drastic increase in CPUE.

However, some new participants to the fishery in 1998 reported CPUE comparable to the more experienced vessels.

Selection of fishing location was based on sea surface temperature patterns downloaded from satellite imagery charts, acoustic assessment of deep scattering layers of plankton and overall signs of life in the area (AMR 1998). The characteristics of good fishing areas are not yet fully understood, however, and squid shoals can enter or leave areas relatively rapidly. The decision to resume searching for a new fishing area was governed by fishing success. The lack of correlation between CPUE and effort (Figure 4) indicates that successful squid jigging is still a 'hit or miss' occurrence.

The relationship of CPUE to sea surface temperature for both years is not as well defined as that observed by Gillespie and Shaw (1997) in the 1996 pilot fishery and Shaw and Smith (1995) in the 1990 and 1991 experimental fisheries. Peak CPUEs in those years were associated with temperatures of 14 to 16 °C. Data were so sparse and CPUE so low in 1997 that no relationship to temperature was apparent (Figure 3). In 1998, CPUEs were generally higher than in previous years over a fairly wide range of temperatures. This may be due in part to the increased use of daytime fishing strategies at considerable depths, and the possible lack of a strong correlation between sea surface temperature and temperature at the depths being fished. Regardless, highest CPUEs were reported at sea surface temperatures around 16°C.

Size composition data collected in 1998 can be compared with the data of Gillespie and Shaw (1997) and Shaw and Smith (1995). The 1998 samples closely resemble female squid samples taken in previous years. As in 1996, the lack of sex-specific information of some samples precludes speculation on whether the lower mean length observed is due to a difference in sex ratio (higher incidence of male squid) or due to the presence of females from the smaller spring-breeding cohort described by Murata and Hayase (1993).

Length-weight relationship parameters (Table 7) and product conversion factors (Table 8) were comparable to those from samples taken in the 1996 pilot fishery (Gillespie and Shaw 1997) and the 1990 and 1991 experimental fisheries (Shaw and Smith 1995).

Dominant bycatch species reported from the experimental fisheries in 1990 and 1991 were blue sharks, rougheye rockfish and pacific pomfret (Shaw and Smith 1995). They also reported capture of single specimens of chinook, coho and pink salmon. In 1996, there were no logbook or observer reports of bycatch of finfish species other than blue sharks (Gillespie and Shaw 1996).

The reported bycatch was much lower than the 10% bycatch allowance. However, discrepancies between harvest logs and the observer data, both of which were incomplete, likely mean that bycatch was underestimated in both years. The observer mentioned blue shark in his report but failed to include numbers, weights or location, as they were caught on handlines, not jigging machines. Discussions with fishers indicated that, because of their tendency to attack hooked squid and foul jigging gear, some blue shark were caught, killed and discarded, and that these sharks do not appear on the logbooks.

Pacific pomfret were reported in 1997 and 1998, but at low levels relative to the 1990 and 1991 fisheries. Pacific pomfret were the most common bycatch (by number) in both day and night operations in the experimental fisheries in 1990 and 1991, and Gillespie and Shaw (1997) speculated whether lack of pomfret taken in the 1996 fishery was indicative of oceanographic conditions which might also have affected abundance of flying squid. Driftnet surveys conducted between 1979 and 1997 found a marked decrease in pomfret abundance in the subarctic domain (Yatsu *et al.* 1998), which was postulated to be an effect of the intensive driftnet fishery that took place between 1978-1992. The low bycatch of pomfret in 1998, when squid catches were relatively high, supports the hypothesis of decreased pomfret abundance, rather than a distributional shift due to oceanographic conditions.

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Table 1. Common and scientific names of squid and fish species taken in Canadian experimental squid jig fisheries. Taxonomy of squids follows Roper *et al.* (1984), fishes after Gillespie (1993). Names commonly used in the fishery are listed first, FAO recommended common names follow in brackets.

Common Name	Scientific Name
Squid	
Red squid (Schoolmaster gonate squid)	*Berryteuthis magister* (Berry, 1913)
Eight-armed squid (Boreopacific gonate squid)	*Gonatopsis borealis* (Sasaki, 1923)
Opal squid (Opalescent inshore squid)	*Loligo opalescens* Berry, 1911
Robust clubhook squid	*Moroteuthis robusta* (Verrill, 1876)
Flying squid (Neon flying squid)	*Ommastrephes bartrami* (LeSueur,1821)
Nail squid (Boreal clubhook squid)	*Onychoteuthis borealijaponica* Okada, 1927
Fish	
Pacific pomfret	*Brama japonica* Hilgendorf, 1878
Pink salmon	*Oncorhynchus gorbuscha* (Walbaum, 1792)
Coho salmon	*Oncorhynchus kisutch* (Walbaum, 1792)
Chinook salmon	*Oncorhynchus tshawytscha* (Walbaum, 1792)
Blue shark	*Prionace glauca* (Linnaeus, 1758)
Rougheye rockfish	*Sebastes aleutianus* (Jordan & Evermann, 1898)
Chub mackerel	*Scomber japonicus* Houttyun, 1782
Jack mackerel	*Trachurus symmetricus* (Ayres, 1865)

Table 2. Summary of flying squid product type definitions.

Product	Description
Tubes	head, arms, tentacles and viscera removed; mantle not cut.
Mantles	head, arms, tentacles and viscera removed; mantle split open.
Mantles (no fins)	head, arms, tentacles, viscera and fins removed; mantle split open
Skinned mantle (no fins)	head, arms, tentacles viscera and fins removed; mantle split open and skinned
Wings	fins
Tentacles/arms	mantle, head and viscera removed.
Heads	mantle, arms, tentacles, viscera and eyeballs removed.
Mixed products	viscera and head removed; mantle split; mantle, fins and tentacles/arms frozen separately, product weights combined.

Table 3. Maturity stages adopted for neon flying squid (from Durward *et al.* (1979)).

Maturity Stage	NGL/DML ratio	Description
1	≤ 0.090	Nidamental gland thin and transparent
2	0.091 to 0.125	Nidamental gland transparent to translucent; ovary appears granular
3	0.126 to 0.200	Nidamental gland translucent to opaque
4	0.201 to 0.350	Nidamental gland white; oviducts forming
5	> 0.350	Eggs in oviducts

Table 4. Total number and weight reported in logbooks and estimated whole round weight from verified landings from the 1997 and 1998 pilot fishery for neon flying squid.

Species	Number		Logbook Weight (kg)		Estimated Weight (kg)	
	1997	1998	1997	1998	1997	1998
Neon flying squid	494	28,023	976	71,445	1,258	63,032
Nail squid	26	0*	14.2	0*	n/a	n/a
Red squid	9[a]	0*	0.4	0*	n/a	n/a
Eight-armed squid	0	23*	0	*	n/a	n/a
Robust clubhook squid	0	2*	0	23*	n/a	n/a
Mackerel	1	0*	0.5	0*	n/a	n/a
Pacific pomfret	3	6*	4.5	*	n/a	n/a
Blue shark	2	11*	40	*	n/a	n/a

[a]Small school of squid that likely followed the jigs to the surface; they were fished with dip net.
*Entries are incomplete, as not all logs reported numbers and/or weights.
n/a: These species were not landed.

Table 5. Neon flying squid CPUE (kg/jig-hr) by year, month, time of day and area (inside or outside Canadian Fishery Conservation Zone [FCZ]). 1990 and 1991 data are from Shaw and Smith (1995) and 1996 data are from Gillespie and Shaw (1997).

Year/Area	Time	May	June	July	August	September	October
1990 Inside	Day	-	-	0.047	0.065	0.038	-
	Night	-	-	0.078	0.089	0.098	-
1990 Outside	Day	-	-	0.064	0.028	-	-
	Night	-	0.056	0.101	0.034	-	-
1991 Inside	Night	-	-	0.053	0.092	-	-
1996 Inside	Night	-	-	0.003	0.053	0.032	-
1996 Outside	Night	-	-	0.002	0.021	0.040	-
1997 Inside	Day	-	-	-	-	-	-
	Night	0.000	*	0.190	0.039	0.003	0.017
1997 Outside	Night	-	-	-	0.027	-	-
1998 Inside	Day	-	-	-	-	-	-
	Night	-	-	-	-	-	-
	Combined	-	-	0.743	1.090	0.950	-
1998 Outside	Day	-	-	-	-	-	-
	Night	-	-	-	-	-	-
	Combined	-	-	0.189	-	-	-

* Logbook information incomplete, CPUE could not be estimated.

Table 6. Neon flying squid mean dorsal mantle length, range of lengths and sample size from experimental fisheries in 1990-91 (Shaw and Smith 1995), 1996 (Gillespie and Shaw 1997) and 1998.

Sample	Sex	Mean Length (cm)	Range	N
July 1990	Female	39.5	29-53	3,996
August 1990	Female	41.7	31-58	2,466
	Male	33.5	32-35	5
September 1990	Female	42.8	30-57	1,971
	Male	33.1	31-38	11
July 1991	Female	45.2	37-55	247
August 1996 BC	Both	41.4	31-50	201
August 1996 OR	Both	34.6	21-51	21
July 1998	n/a	37.9	30-52	99
August 1998	Female	40.1	32-53	204
	Male	35.3	33-39	15
September 1998	Female	44.1	33-54	504

Table 7. Neon flying squid length-weight relationship parameter estimates from experimental fisheries in 1990-91 (Shaw and Smith 1995), 1996 (Gillespie and Shaw 1997), 1997 and 1998.

Sample	a	b	n
August 1990	0.311	2.411	114
September 1990	0.702	2.194	93
July 1991	0.092	2.700	247
August 1996 North	0.132	2.613	201
August 1996 South	0.042	3.009	21
July 1998	0.218	2.500	99
August 1998	0.455	2.323	84

Table 8. Neon flying squid product conversion factors from experimental fisheries in 1990-91 (Shaw and Smith 1995), 1996 (Gillespie and Shaw 1997), and 1998.

Product Type	1990-91		1996		1998	
	RR	CF	RR	CF	RR	CF
Tubes	49.6%	2.01	n/a	n/a	50.9%	1.97
Mantles (with fins)	45.6%	2.19	48.4%	2.06	n/a	n/a
Mantles (without fins)	n/a	n/a	n/a	n/a	41.4%	2.42
Skinned Mantles (without fins)	n/a	n/a	n/a	n/a	37.1%	2.69
Wings	n/a	n/a	n/a	n/a	11.1%	9.04
Tentacles/Arms	18.0%	5.56	17.7%	5.64	19.5%	5.14
Heads	5.9%	16.95	n/a	n/a	n/a	n/a
Mixed Products	n/a	n/a	59.9%	1.67	n/a	n/a

Table 9. Total catch of neon flying squid from Canadian experimental driftnet and jig fisheries off the west coast of North America.

Year	Jig Catch (kg)	Driftnet Catch (kg)	Reference
Sep 1979	414	10,599	Bernard (1980)
Jul-Aug 1980	-	130,045	Bernard (1981)
Jul-Aug 1983	64	32,986	Robinson and Jamieson (1984)
Jul-Aug 1983	1,475	329,561	Sloan (1984)
Jul-Sep 1985	-	771,130	Jamieson and Heritage (1987)
Jun-Sep 1986	-	1,110,527	Jamieson and Heritage (1987)
Jun-Aug 1987	71	1,527,476	Jamieson and Heritage (1988)
Jun-Sep 1990	320,274	-	Shaw and Smith (1995)
Jul-Aug 1991	3,820	-	Shaw and Smith (1995)
Aug 1996	7,434	-	Gillespie and Shaw (1997)
May-Oct 1997	1,258	-	this report
Jul-Sep 1998	63,032	-	this report

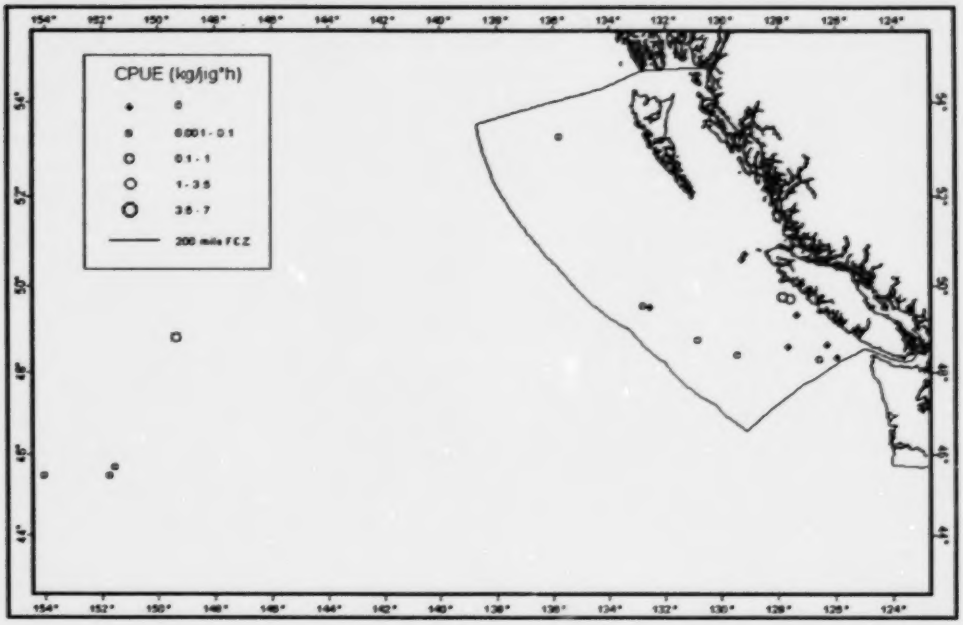

Figure 1. Fishing locations and relative CPUE (kg/jig-hr) by operation from 1997 neon flying squid logbook data. Data ranges from 0 to 0.257 (kg/jig-hr).

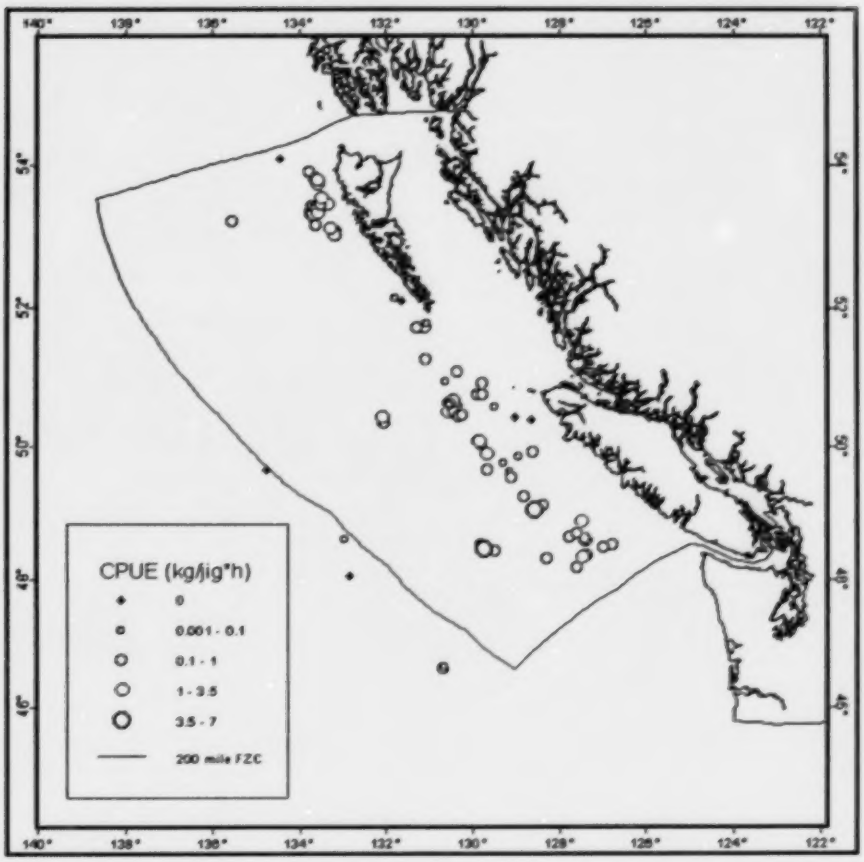

Figure 2. Fishing locations and relative CPUE (kg/jig-hr) by operation from 1998 neon flying squid logbook data. Data ranges from 0 to 6.498 (kg/jig-hr).

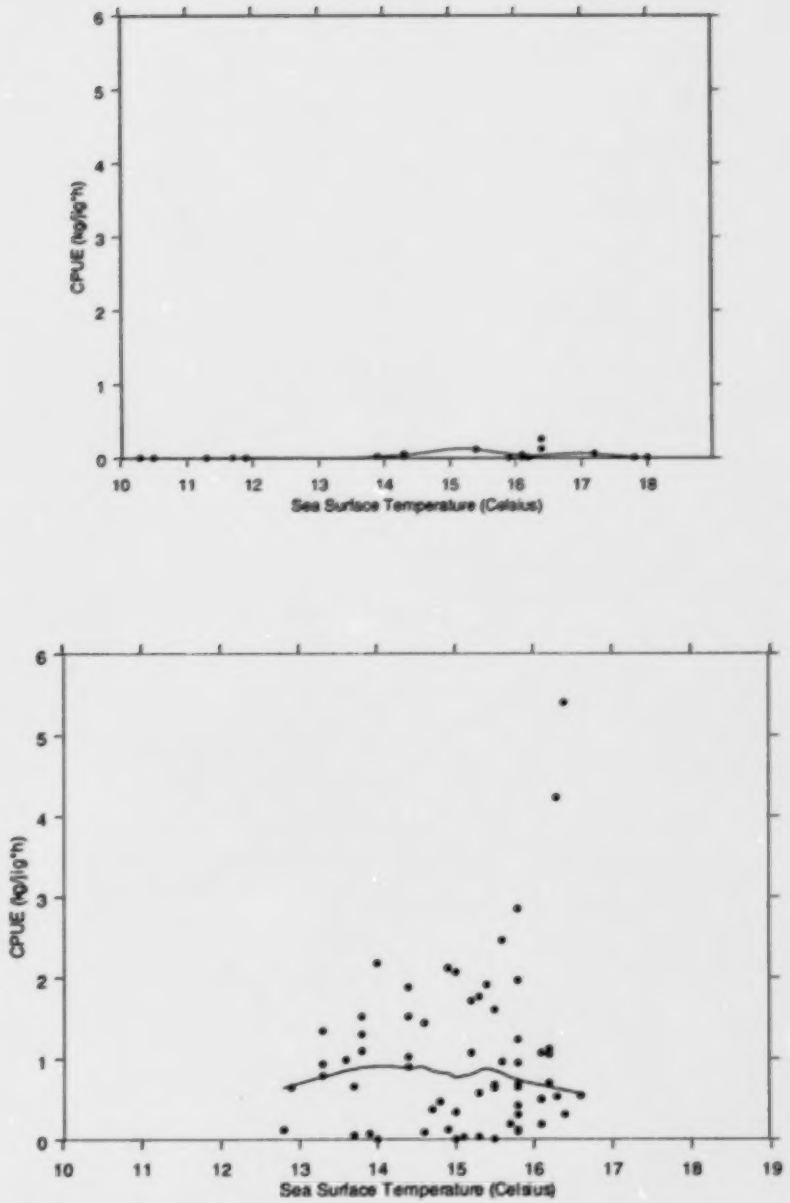

Figure 3. CPUE (kg/jig-hr) versus temperature (°C) from neon flying squid logbook data in 1997 (top panel) and 1998 (bottom panel), with a fitted locally-weighted smooth line (StatSci 1995).

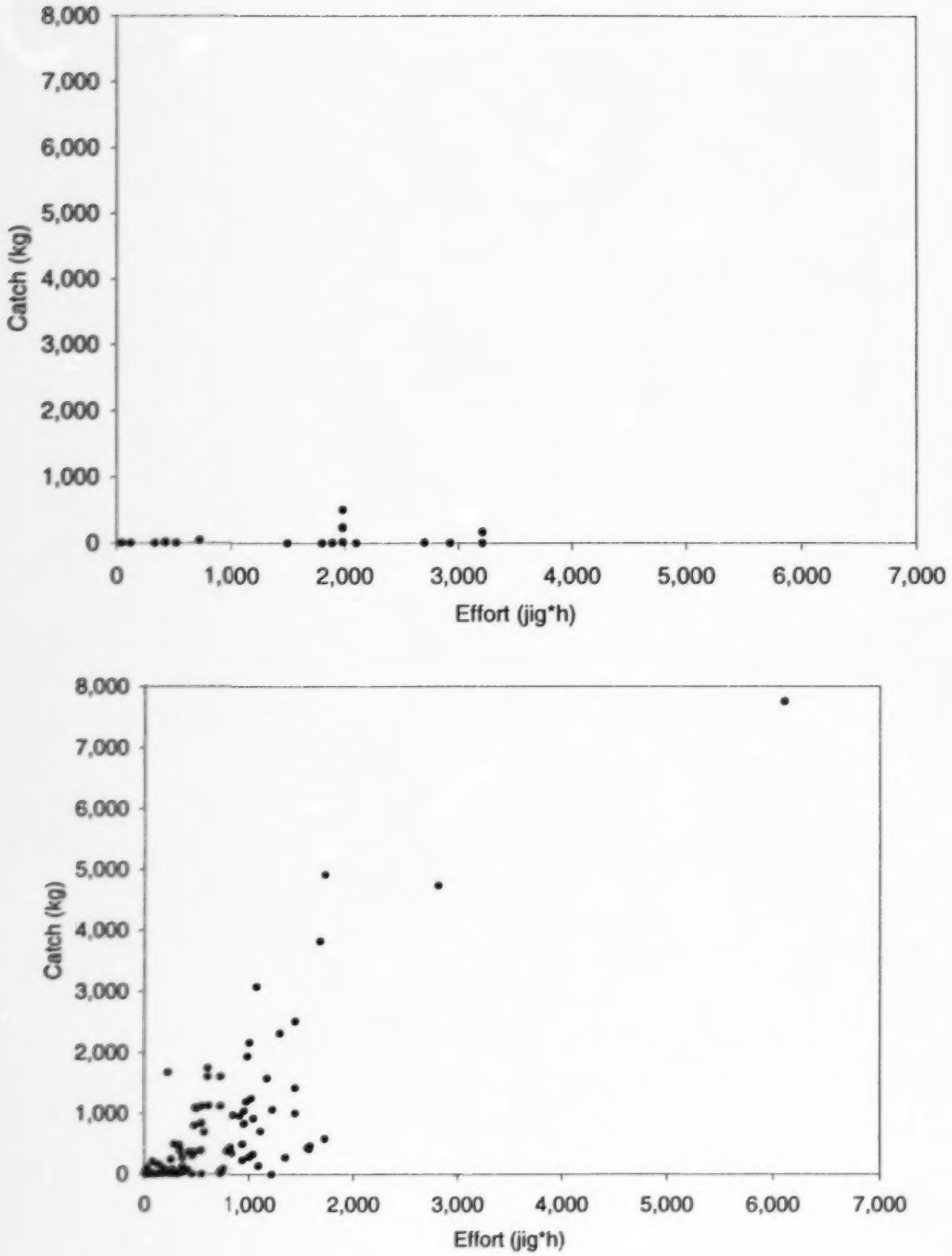

Figure 4. Estimated catch (kg) versus effort (jig-hr) from neon flying squid logbook data in 1997 (top panel) and 1998 (bottom panel).

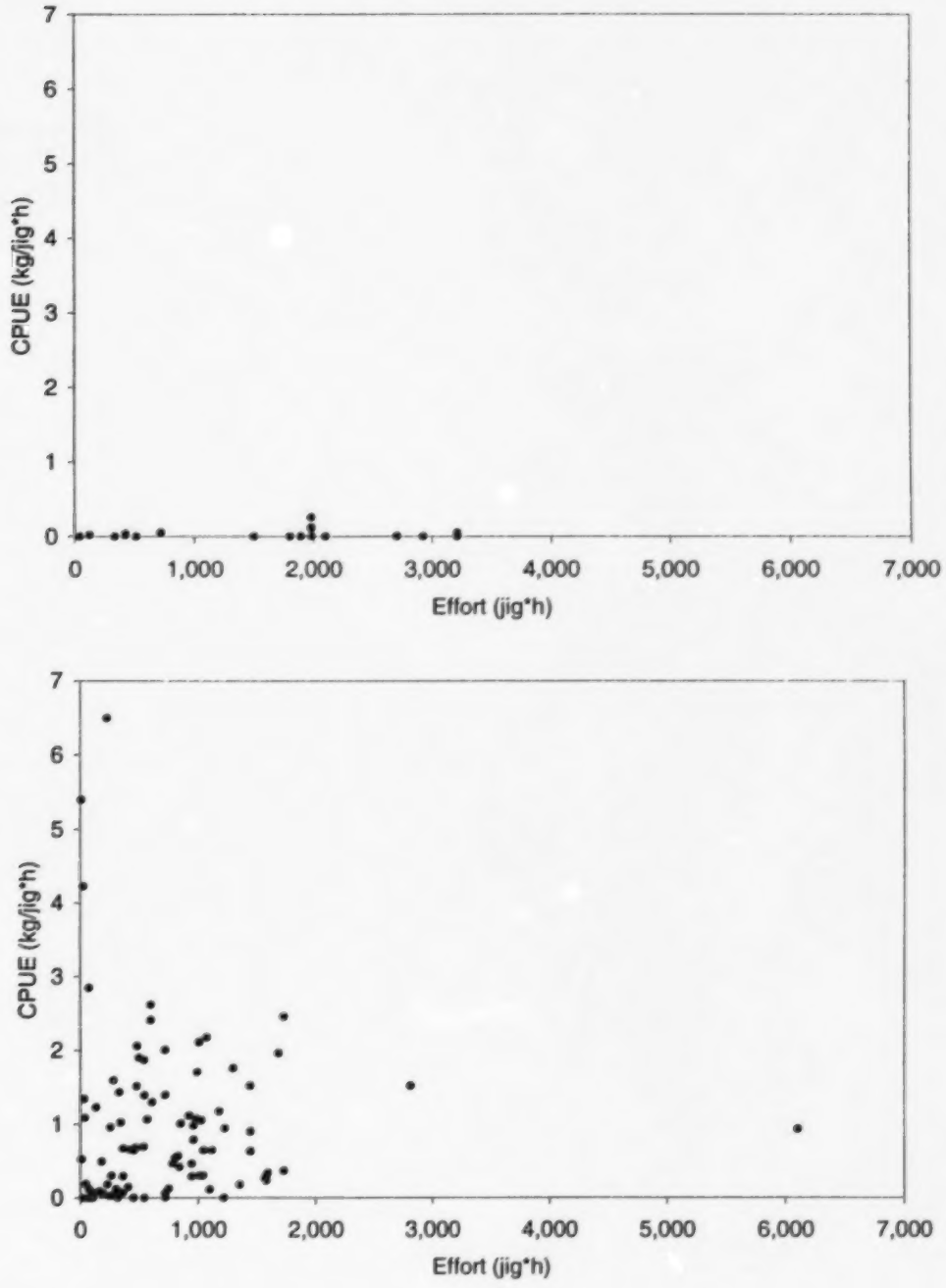

Figure 5. CPUE (kg/jig-hr) versus effort (jig-hr) from neon flying squid logbook data in 1997 (top panel) and 1998 (bottom panel).

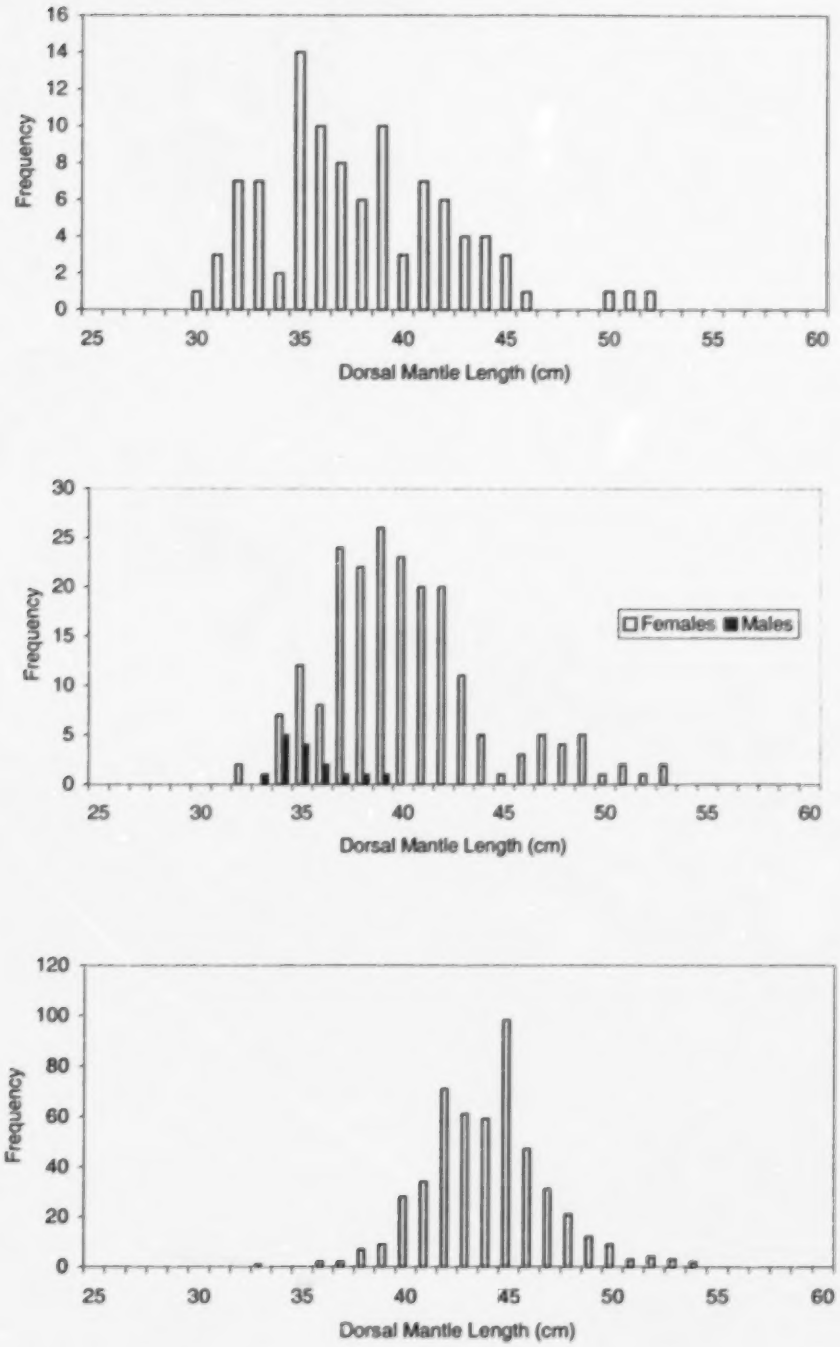

Figure 6. Frequency of dorsal mantle lengths (cm) of neon flying squid sampled off British Columbia in July (top panel, n=99), August (middle panel, n=219) and September (bottom panel, n=504) 1998.

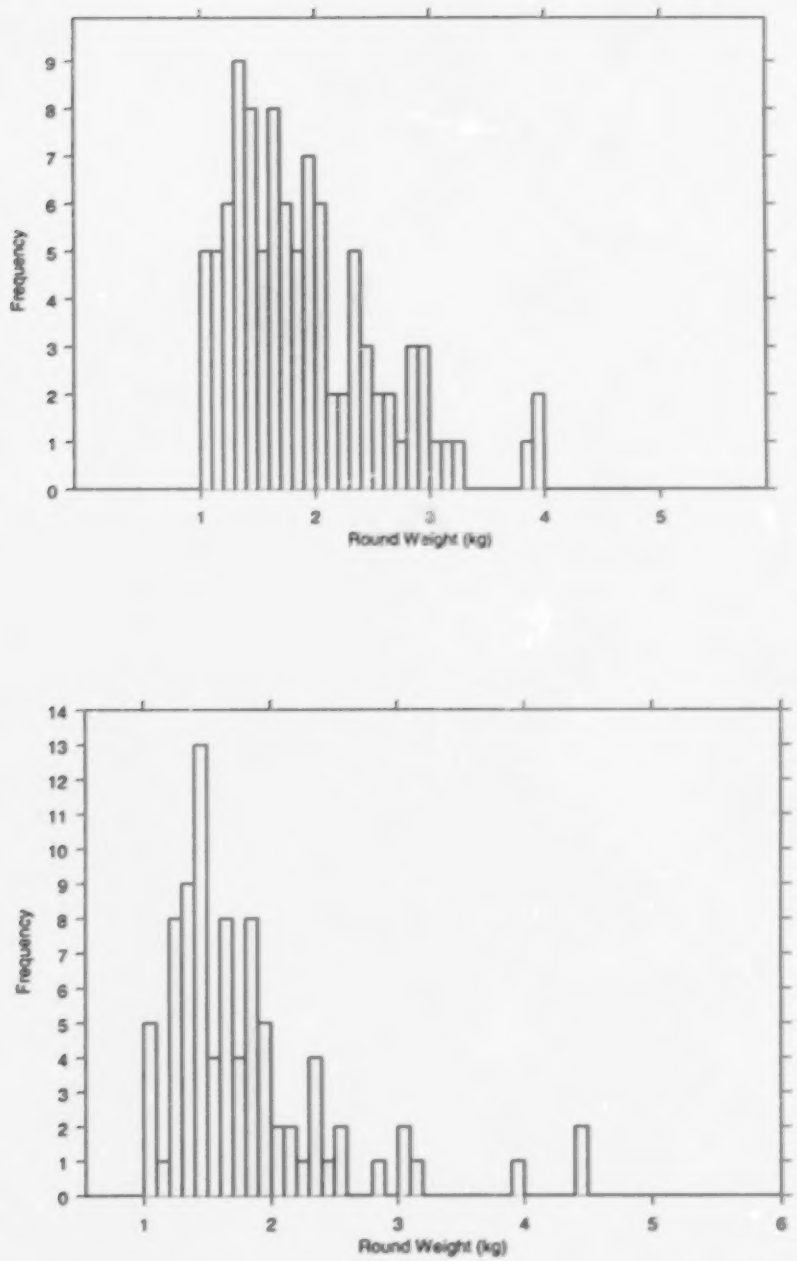

Figure 7. Frequency of whole round weights (kg) of neon flying squid sampled off British Columbia in July (top panel) and August (bottom panel) 1998.

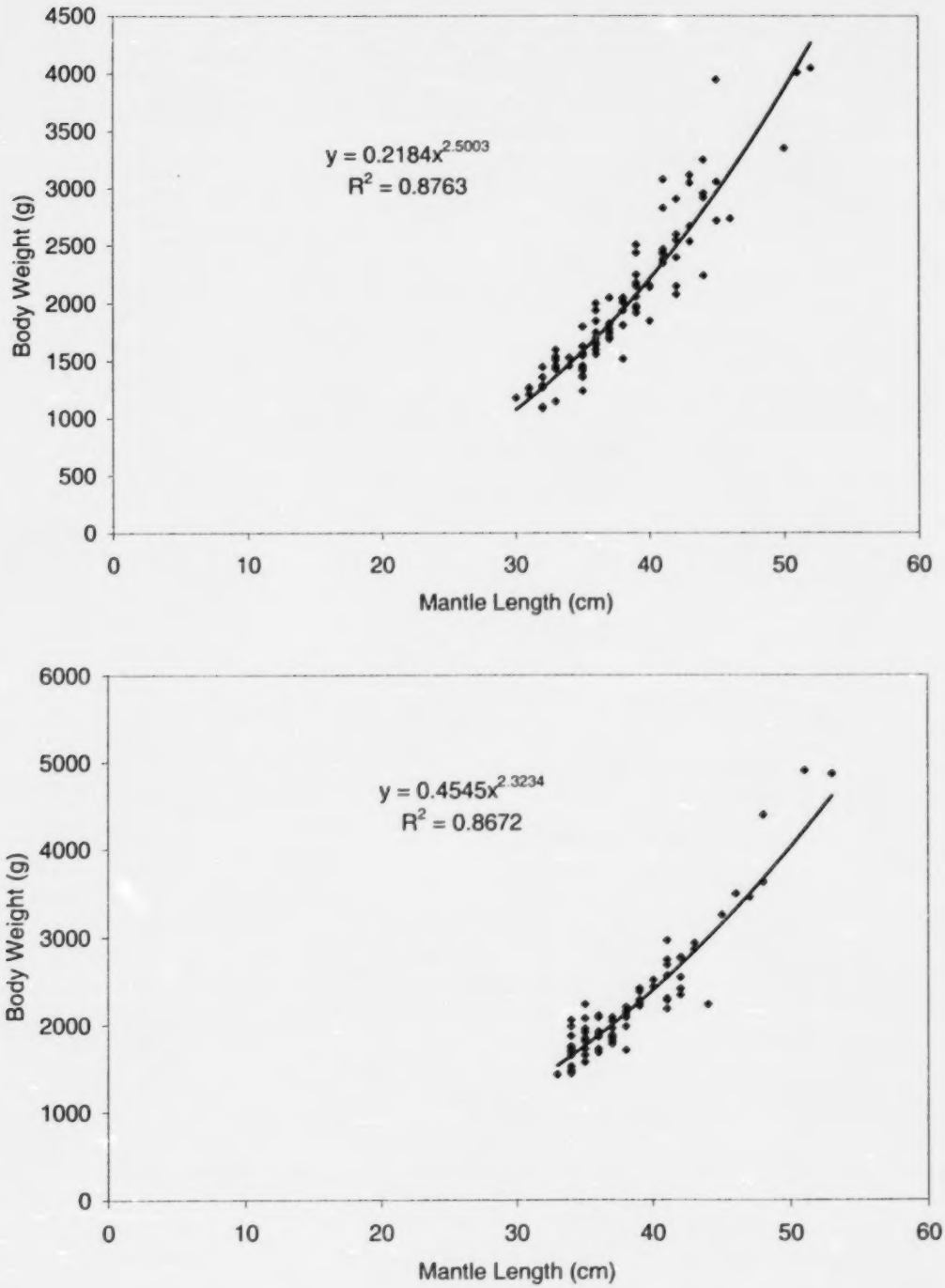

Figure 8. Length-weight relationships for neon flying squid sampled in July (top panel) and August (bottom panel) 1998.

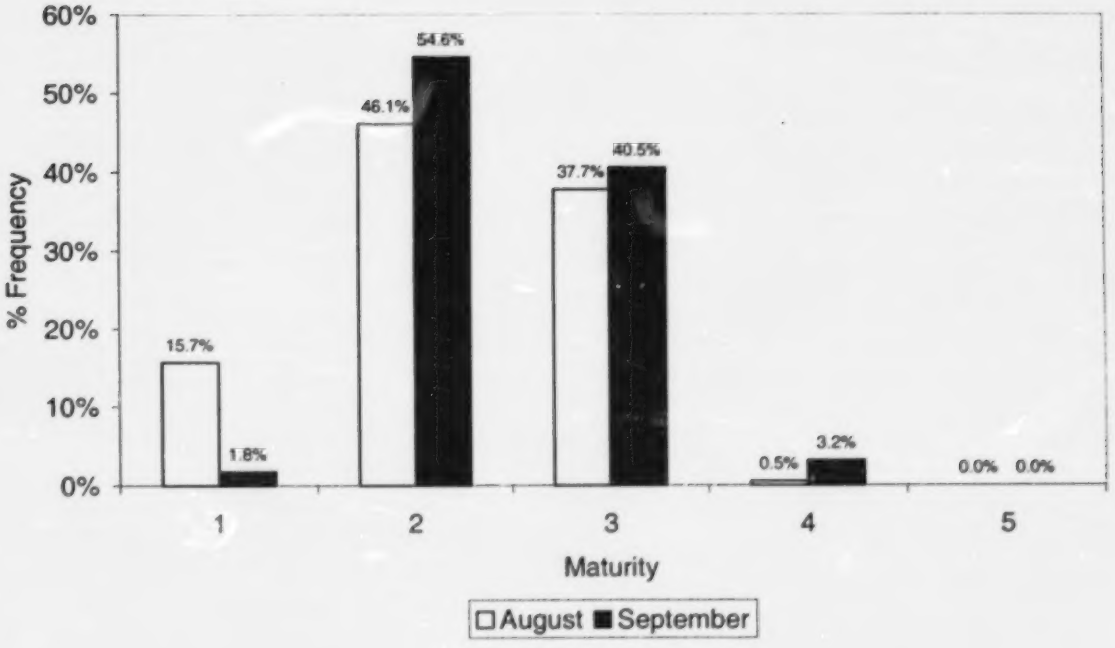

Figure 9. Percent frequency of maturity stage by month of female neon flying squid sampled off British Columbia in 1998.

APPENDIX 1

1997 AND 1998 NEON FLYING SQUID MANAGEMENT PLANS AND CONDITIONS OF LICENCE

PACIFIC REGION

1997 EXPERIMENTAL

FISHERY PLAN

NEON FLYING SQUID

This Neon Flying Squid Management Plan is intended for general purposes only. Where there is a discrepancy between the Plan and the regulations, the regulations are the final authority.

Fisheries and Oceans Canada
Pêches et Océans Canada
Canada

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1. DFO CONTACTS FOR FURTHER INFORMATION

Regional Shellfish Co-ordinator	Bruce Adkins	(250) 756-7285
International and Intergovernmental Affairs		
Regional Headquarters 317-555 West Hastings St. Vancouver, B.C. V6B 5G3	Sandy Argue	(604) 666-8192
Fisheries Management Sector		
Harvest Management Unit Fisheries Operations Branch 3225 Stephenson Point Road Nanaimo, B.C. V9T 1K3	William Shaw	(250) 756-7152
Science Branch		
Pacific Biological Station Hammond Bay Road Nanaimo, B.C. V9R 5K6	Graham Gillespie	(250) 756-7215
Inspection Branch		
Shellfish Inspection Specialist 2250 South Burnaby Rd. Burnaby, B.C. V5M 4L9	Klaus Schallie	(604) 666-4427 (ext. 277)
Commercial Licensing		
Commercial Licence Unit 400-555 West Hastings Street Vancouver, B.C. V6B 5G3		(604) 666-0566
Commercial Licence Unit 417 - 2nd Ave. West Prince Rupert, B.C. V8J 1G8		(604) 627-3413
Commercial Licence Unit 60 Front Street Nanaimo, B.C. V9R 5H7		(250) 754-0400

Aboriginal Fisheries Division

South Coast Manager	Colin Masson	(250) 756-7001
North Coast Manager	Dale Gueret	(250) 627-3464
Fraser River Manager	Burt Ionson	(604) 666-2032

2. MAFF CONTACT FOR FURTHER INFORMATION

Fisheries Branch

Ministry of Agriculture, Fisheries and Food 1st Floor, 808 Douglas St. Victoria, B.C. V8W 2Z7	Dave Smith	(250) 356-7642

3. GOALS AND OBJECTIVES

3.1. To ensure a long-term sustainable fishery.

3.2. For data limited fisheries to take a precautionary approach to fisheries management.

3.3. To develop management strategies and fishing plans in consultation with Stock Assessment and clients to provide fishery data to help understand the fishery resources.

3.4. Where fishery data will not meet stock assessment requirements, develop a process with the clients to fund or collaborate in the collection of fishery independent data.

3.5. Develop fishing strategies and management plans where users are accountable for compliance with conservation standards and for meeting harvesting conditions.

3.6. Develop partnerships with users, where the users participate more in the management of the fishery and share the results and costs of the increased involvement.

3.7. Explore opportunities for developing fisheries outside of Canada's Fishery Conservation Zone (FCZ) consistent with Canada's international obligations.

4. HISTORY OF THE FISHERIES

NEON FLYING SQUID

Neon Flying Squid (*Ommastrephes bartrami*) is an oceanic species found world-wide in subtropical and temperate oceanic waters. In the North Pacific Ocean neon flying squid are distributed within thermal boundary zones between warm and cold waters (15^0C to 24^0C), particularly from July to August. Neon flying squid have been the target of the Asian fishery for many years. Historically, it started with the jig fishery operating in small boats around the coastal areas off Japan. The fishery expanded offshore to areas in the North Pacific Ocean using monofilament gillnets, or commonly referred to as driftnets. Between 1978 and 1992 the average annual landings exceeded 200,000 tonnes. After June 30, 1992 an international moratorium (U.N. resolution 44/225) on high seas driftnet fishing was put into effect, which resulted in annual shortfalls of squid on the world markets of approximately 100,000 tonnes.

Driftnets were deemed more effective in catching squid than jigs, however the non-selective nature of driftnets and impacts of the fishery on commercially important fish stocks, marine mammals, reptiles, and seabirds led to research into alternative harvest methods by both the Japanese and the Canadian fishing industries. For example, in 1990 and 1991 a DFO/Japan co-operative venture used commercial Japanese jig vessels to harvest squid inside Canadian waters. The results of these studies have shown that neon flying squid do occur in varying abundance in the Fishery Conservation Zone (FCZ) during summer months and that distribution and abundance is linked to specific ocean temperatures (i.e. 15^0 C and 16^0 C). These experimental fisheries and other studies have also demonstrated a spatial segregation of groups of different sized squid (>35 cm mantle length), mainly females. These larger sized squid occupy areas of the NE Pacific as far north as 50^0 N latitude in the spring and summer and become rare in September. In recognition of this and recent developments in gear technology, opportunities exist for the possible development of a jig fishery for neon flying squid off the west coast of British Columbia during June to September.

In December 1995, Canada and British Columbia signed a Memorandum of Understanding on Fisheries and Seafood Diversification (MOU). The objective of this MOU was to provide an orderly approach to new commercial fishing opportunities in British Columbia. A Federal-Provincial Committee was formed under the auspices of the MOU and developed operational guidelines for the implementation of the three year pilot fishery for neon flying squid.

In 1996 a total of 53 applications for entry into the exploratory jig fishery for the neon flying squid were received by DFO. These applications were evaluated for eligibility, based on a criteria for entry (Section 6.5.1) established, by the joint DFO/ MAFF Seafood Diversification Committee. Twenty applicants were determined to be eligible to apply for the two licences required for this fishery. These licences are; a licence to fish for experimental, scientific, educational, or public display purposes (under s. 52 of the

Fishery (General) Regulations), and a licence to fish or trans-ship fish in waters other than Canadian Fisheries Waters (under s. 68(1) of the Fishery (General) Regulations). The licences for neon flying squid are non-transferable licences but may be renewed for 1997 and 1998 under the following conditions: compliance with all conditions of the licence, diligent use is made of the licence, and all required fees are paid.

A precautionary total allowable catch (TAC) of 1,500 metric tonnes of round weight was established for the 1996 fishery. Only seven applicants reported participation in the fishery. Six vessels submitted logbooks for a total catch of 4,433 neon flying squid or an estimated total landed weight of 7,434 kg. The reason for the low landings was in part due to the inexperience of the fishers to the new fishing technology, and the possible anomalous ocean conditions off the west coast of British Columbia during the fishing season. It is interesting to note that the 1996 Canadian albacore tuna fishery, which occurs in the same region as flying squid, was also poor.

The results of the 1996 season were reviewed by Government and Industry to determine the feasibility of the automated jig fishery, examine the 1996 distribution and abundance of this species within and adjacent to the FCZ, assess the effectiveness of the current models of automated jig technology, and collect biological and by-catch information to support sound fisheries management decisions.

A precautionary approach will be continued for the neon flying squid fishery in 1997 and the TAC will remain at 1,500 metric tonnes of round weight for this species.

SCHOOLMASTER GONATE, BOREAL CLUBHOOK, AND BOREOPACIFIC GONATE SQUID

For 1997 three additional species of squid will be permitted to be harvested under this fishing plan. These include; schoolmaster gonate squid, boreal clubhook squid, and boreopacific gonate squid. Although these species are known to occur in the FCZ little is known of their distribution and abundance. A precautionary TAC of 75 tonnes (5% of the neon flying squid TAC) has been established for each of these species for 1997. This will allow fishers additional opportunities to improve their efficiency of the new jig equipment and to learn how to use the new technology for targeting the neon flying squid.

The results of the 1997 season will be reviewed by Government and Industry to determine the feasibility of the automated jig fishery for these additional species, examine the distribution and abundance of these species within and adjacent to the FCZ, and collect biological information to support sound fisheries management decisions. Since this is a new fishery, a precautionary approach will be taken for the 1997 season.

5. ENFORCEMENT PLAN

The Conservation and Protection Sector of the Department of Fisheries and Oceans has the responsibility to enforce the Fisheries Act and associated regulations, to address conservation, health and safety issues and to maintain proper management and control of the various fisheries.

Users of the resource have a responsibility to report violations. Any suspected or actual fisheries, wildlife or pollution violations can be quickly and discretely reported to the appropriate Enforcement Officer by using the toll free Observe, Record and Report hotline. This toll free number is available 24 hours a day. Confidentiality is assured.

OBSERVE, RECORD AND REPORT - 1-800-465-4DFO (1-800-465-4336)

Enforcement enquiries can also be directed to the local Field Offices during regular office hours.

6. EXPERIMENTAL FISHING PLAN

6.1. MANAGEMENT CHANGES FOR 1996/97

6.1.1. The fishery will open May 12 and close on December 31, 1997 or when the TAC has been achieved.

6.1.2. Fishing will be permitted in all Canadian fisheries waters in Canada's Fishery Conservation Zone (FCZ) and all high seas waters of the Pacific Ocean. (see section 6.4.)

6.1.3. Diligent use has been changed from an annual catch of 10,000 pounds round weight of neon flying squid to 1% of the total aggregate catch, in round weight, of neon flying squid landed prior to the end of the three year pilot period. (see section 6.5.3.)

6.1.4. Three additional species of squid may be harvested. These include; schoolmaster gonate squid *(Berryteuthis magister)*, boreal clubhook squid (*Onychoteuthis borealijaponica*), and boreopacific gonate squid (*Gonatopsis borealis*). The precautionary TAC for each of the three species is 75 t. (see section 6.5.4)

6.1.5. The by-catch allowance for other squid and non-restricted species has been increased to 10 percent of the total catch weight of neon flying squid per trip. (see section 6.5.5.)

6.2. Open Times

The fishing period shall begin on May 12 (0001 hr) and end on December 31 (2359 hr), 1997 or when the TAC set for all species for the fishery is reached. All vessels will be required to land all catch within 10 days of the closure.

6.3. Fishing Activities Outside Canadian Waters

The licence holder is only permitted to carry out fishing activities that are in compliance with the applicable regulations of existing international fisheries management and conservation measures for the high seas area.

In order to fish in the waters of any state(s) other than Canada, the licence holder must apply to, and receive from the Department, a licence amendment, and upon application satisfy the Department that all relevant arrangements have been approved by the state(s) concerned.

6.4. Fishing Area

All harvesting shall be conducted in Canadian fisheries waters of the Pacific Ocean, and in waters of any state(s) other than Canada, as described in section 6.3.

6.5. Licensing

Only Canadian registered licensed fishing vessels with schedule II species privileges will be considered for a licence. In order to be eligible for a licence the vessel must also comply with the eligibility criteria established by the joint DFO/MAFF Seafood Diversification Committee for this fishery.

Experimental Neon Flying Squid licences will not guarantee the licence holder a permanent licence in this fishery. However, their participation will be reviewed and they may be given priority in a more permanent licence system, if one occurs.

6.5.1. Vessel Selection Criteria

6.5.1.1. Licensed to fish in west coast Canadian waters (i.e., has C licence privileges).

6.5.1.2. Minimum vessel at-sea endurance of two weeks (as measured by the vessel's fuel capacity).

6.5.1.3. A 100 kHz (minimum) echo sounder.

6.5.1.4. Instrumentation for sea surface temperature monitoring and recording.

6.5.1.5. On-board freezing capabililty to freeze to a core temperature of -5^{0}F within 3 hours with a thermal arrest period of no longer than two hours and a holding capacity of 25,000 pounds.

6.5.1.6. A 50 kilowatt (minimum) generator.

6.5.1.7. Suitable accommodation and workspace for a DFO certified observer.

6.5.1.8. To have installed on the vessel a minimum of four automatic jigging machines (a plan, to scale, of the vessel's deck layout with the jigging machines is required with the application).

6.5.1.9. Vessel and crew must comply with private insurance standards for fishing in these waters.

6.5.2. Licence Category:

The following licences are required to harvest neon flying squid: (1) a licence to fish for experimental, scientific, educational or public display (under s. 52 of the Fishery (General) Regulations). This is a personal, non-transferable licence that must designate the vessel to be used for fishing. The person or company issued this licence will be considered the licence holder of record, and (2) a licence to fish or trans-ship fish in waters other than Canadian Fisheries Waters (under s. 68(1) of the Fishery (General) Regulations). This is a vessel licence, for the same vessel designated by (1). The fee for this offshore licence is $500.00.

6.5.3. Diligent use is made of the licence if 1% of the total agregate catch, in round weight, of neon flying squid is landed by a vessel prior to the end of the three year pilot period in 1998.

6.5.4. Species:

Neon Flying Squid (*Ommastrephes bartrami*), Schoolmaster gonate squid (*Berryteuthis magister*), Boreal clubhook squid (*Onychoteuthis borealijaponica*), and Boreopacific gonate squid (*Gonatopsis borealis*).

6.5.5. By-Catch Restrictions:

A by-catch allowance of 10 percent of the total catch weight of neon flying squid per trip will be permitted for other squid species, pomfret and blue shark in aggregate. Other species caught must be returned to the water in the best possible condition.

6.5.6. Total Allowable Catch per Year:

The TAC is set at 1,500 metric tonnes (t) of round weight of neon flying squid and 75 t , round weight, for each of; schoolmaster gonate, boreal clubhook squid, and boreopacific gonate squid. The fishery will be closed when the annual quota is reached for all species. Conversion factors will be determined in-season to convert processed squid weights to round weights. This precautionary quota will be reviewed in-season, taking account of available information from the exploratory fishery.

6.5.7. Gear:

The fishery will be conducted using "squid jigs" operated by automated jigging machines. Each vessel must have installed a minimum of four automated, double spooled jigging machines and may carry a maximum of 20 double spooled machines. In addition, hand jig equipment are allowed as a supplemental gear type to jig machines.

6.6. Notification Prior To Commencing Fishing And Prior To Delivering

(1) Before a Fishing Trip:

The vessel master shall, 24 hours prior to commencing fishing for neon flying squid, personally advise or call by radio or phone Archipelago Marine Research (AMR) at the following number **1-800-663-7152** and advise of the following:

(a) vessel name and vessel registration number (CFV#);

(b) the location, by latitude and longitude, of the fishing activity;

(c) the anticipated date and time of arrival at the fishing location;

(d) the anticipated date and time that fishing will begin; and

(e) if applicable, a decision to cancel a previous notification of a fishing trip.

(2) Prior to delivering:

The vessel master shall, at least 24 hours prior to delivering his squid catch to a port, advise AMR at **1-800-663-7152** by radio, by phone, or in person of:

(a) vessel name and vessel registration number (CFV#);

(b) intention to deliver a load of squid to a landing port or offload to a fish processor/buyer or fish packer;

(c) the name of the port and location therein where the catch shall be offloaded;

(d) the anticipated time of offloading at that place;

(e) the fish processor/buyer that is buying or offloading the catch; and

(f) the method of transporting the catch to a fish processor.

6.7. Validation Of Landings

At the time of offloading the Observer shall record the weight of each product type for each species and this weight shall be recorded by the Observer in a DFO approved validation log. The Neon Flying Squid Validation Log issued by the Eastern Pacific Squid Inc. (Tel: (604) 583-2125, or (604) 925-9648) is approved for both form and content by the DFO Shellfish Data Unit. Any alternative to this Validation Log must be approved by the DFO Shellfish Data Unit prior to use.

6.8. Catch Reporting

6.8.1. Harvest Log Data:

The vessel master is responsible for the provision and maintenance of an accurate record, a "log" of daily harvest operations. This log must be completed and a copy submitted in both hard copy (paper) and electronic form in an approved format as defined by the DFO Shellfish Data Unit, Stock Assessment Division. Logbooks meeting DFO requirements are available from outside service bureaus who, for a fee, will provide both logbook and keypunch services, thus complying with the requirement for both a hard (paper) and electronic copy. The original white page copy of the log and the electronic copy must be forwarded, following seven (7) days of each landing, to:

Fisheries and Oceans Canada
Shellfish Data Unit
Pacific Biological Station
Hammond Bay Road
Nanaimo, BC V9R 5K6
Tel. (250)756-7022 or (250)756-7215
Fax. (250)756-7138

As an alternative to the above, the vessel master may provide a log in the same form and providing the same particulars as shown in the fishing log sample in Appendix I. The vessel master must also provide an electronic copy which is required to be a true and accurate transcription of the hard copy, delivered on a DOS compatible 3.5" diskette. Diskettes will remain the property of DFO. The electronic copy must be either:

a) an ASCII text file in the data format specified by the DFO Shellfish Data Unit, or

b) the equivalent information in a database table of approved design created by any of the following database management tools: Access, FoxPro, Paradox or dBase.

Contact the DFO Shellfish Data Unit at the above address for information on the acceptable database table design. Both the hard copy and electronic copy must be forwarded at each landing to the above address.

Catch information must be recorded in the harvest log by 1200hrs in the applicable time zone of the day in which a fishing operation was completed. These logs are to be kept aboard the licensed vessel when shellfish are being harvested or when shellfish are on board. Logbooks must be produced for examination by a Fishery Officer or Guardian.

The licence holder of record, recorded with the Commercial Licence Unit, is responsible to ensure that the vessel master has completed and submitted a copy of the logbook data. DFO can only release log data to the reported vessel owner, and only upon written request.

FISHERIES AND OCEANS CANADA WISHES TO REMIND FISHERS THAT IT IS A CONDITION OF LICENCE THAT LOGS BE COMPLETED, TO DFO STANDARDS, DAILY FOR EACH DAY FISHED AND VALIDATED AT THE TIME OF OFFLOADING BY A CERTIFIED DFO OBSERVER. A COPY OF THE LOG AND ELECTRONIC DATA MUST BE FORWARDED TO THE DFO SHELLFISH DATA UNIT IN NANAIMO FOLLOWING SEVEN DAYS OF EACH LANDING. DELAY OF COMPLETION OR SUBMISSION OF LOGS IS A VIOLATION OF A CONDITION OF LICENCE.

6.8.2. Fish Slip Requirements:

It is a condition of this licence that an accurate written report shall be furnished on a fish slip of all shellfish caught under the authority of this licence. A report must be made even if the shellfish landed are used for bait, personal consumption, or otherwise disposed. The written report

shall be posted not later than seven (7) days after the offloading and sent to:

Fisheries and Oceans Canada
Catch Statistics Unit
Stn. 416, 555 West Hastings Street
Vancouver, B.C. V6B 5G3
Tel: (604) 666-3784

Fish slip books are available on request at the above address.

7. ON GROUNDS OBSERVER

When requested by DFO a vessel must carry a DFO certified Observer to collect biological samples and information regarding species composition, size, sex, reproductive state of the target species, and by-catch of non-target species. This is in reference to subsection 6(2) where vessels are required to carry an Observer, upon request of the Regional Director General, for a specified number of trips. An independent firm will be contracted by industry to provide observer services, which meet DFO requirements. Fishers wishing to use observers from other service agencies must contact DFO to ensure approval.

In lieu of carrying an Observer and subject to the approval of (DFO), the vessel master shall bring either whole squid for sampling or specific biological samples (see section 7.2) to port. The fisher is requested to notify DFO upon return of the sample.

7.1. Duties Of The On Ground Observer

7.1.1. At sea detailed monitoring of catch and effort of squid species.

The observer will document detailed information for each fishing operation regarding specific fishing configurations (machine type; lighting arrangement; number, type and spacing of jigs; number, type and spacing of line lights; retrieval rates; etc.), weather and oceanographic conditions, and the catches that these configurations produce. This information is required to develop standardised measures of catch per unit effort (CPUE) to be used in assessment of squid stocks.

Note: A fishing operation is defined as the period when the lines are put into the water to start fishing, at a particular location, to the time when the lines leave the water to stop fishing.

7.1.2. At sea processing conversion factors.

The observer will document yields of specific products (tubes, split mantles, head-and-arms, etc.) from whole fresh squid. These factors are required to convert landings (weights of products) to whole round weight of squid caught.

7.1.3. At sea monitoring and documentation of bycatch.

The observer will be required to provide detailed catch and effort of non-target species (by-catch) and record drop-off rates while fishing for squid species.

7.2. Biological Sampling

Observer(s) will regularly collect biological information from representative samples of the catch. Biological characteristics include dorsal mantle length, whole round weight, sex and sexual maturity. Additional sampling for morphometric relationships (arm and tentacle length relative to dorsal mantle length) and collection of statolith samples for ageing will also be required. This will be used to further our knowledge of the biological characteristics of stocks of squid in the fishing area throughout the season.

8. ATTACHMENTS

Appendix 1a and b. Example of the harvest log for the neon flying squid licence.

FLYING SQUID HARVEST LOG
Vessel Configuration Form

YEAR: _____ VESSEL: _____ SET NO. FROM: _____

CFV: _____ SKIPPER: _____ TO: _____

JIG MACHINES

	Make	Model	Code	No. of Machines	Spools/machine
1.					
2.					
3.					

LIGHTS

	Bulb Wattage	Colour	Type	No. of Bulbs
1.				
2.				
3.				
4.				
5.				
6.				

STANDARD FISHING CONFIGURATION

1. Wheelhouse jig computer? Yes ☐ No ☐

2. Sounder Type: _____ Make: _____ Frequency: _____

3. Satcom Telephone Number: _____

4. Cellular Telephone Number: _____

COMMENTS

Appendix 1a. Example of the harvest log for the neon flying squid licence.

FLYING SQUID HARVEST LOG
Harvest Log

No. 00001

YEAR: _____ VESSEL: _____ SKIPPER: _____

SET NO: _____ BIOLOGICAL SAMPLE TAKEN? YES: ☐ NO: ☐

FISHING OPERATION SUMMARY

	Month	Day	Time (24h)	Latitude (Deg/min)	Longitude (Deg/Min)	Surface Temp (°C)	Moon Phase	% Overcast	Wind Spd (knts)
Start									
Finish									

SET CONFIGURATION Depth in: Metres ☐ OR Fathoms ☐

	No. of Lines	No. of Jigs/Line	Jig Space (cm)	Haul Rate (cm/s)	Depth Fished Max.	Depth Fished Min.	
1.							
2.							
3.							
4.							

LANDINGS Weight in: Kilograms ☐ OR Pounds ☐

Squid Species	Code	No.	Weight	Comments
Neon Flying				
School Master Gonate				
Nail				
Eight-arm				
Other Squid:				
1. Opal				
2. _____				
3. _____				

Bycatch Species	Code	No.	Weights	Comments
1. Blue Shark				
2. Pomfret				
3. _____				
4. _____				
5. _____				
6. _____				
7. _____				

COMMENTS

Appendix 1b. Example of the harvest log for the neon flying squid licence.

PACIFIC REGION

1998 EXPERIMENTAL

FISHERY PLAN

NEON FLYING SQUID

This Neon Flying Squid Management Plan is intended for general purposes only. Where there is a discrepancy between the Plan and the regulations, the regulations are the final authority.

Fisheries and Oceans Canada
Pêches et Océans Canada
Canada

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1. DFO CONTACTS FOR FURTHER INFORMATION

Regional Shellfish Co-ordinator	Bruce Adkins	(250) 756-7285
International and Intergovernmental Affairs		
Regional Headquarters 317-555 West Hastings St. Vancouver, B.C. V6B 5G3	Sandy Argue	(604) 666-8192
Fisheries Management Sector		
Harvest Management Unit Fisheries Operations Branch 3225 Stephenson Point Road Nanaimo, B.C. V9T 1K3	William Shaw	(250) 756-7152
Science Branch		
Pacific Biological Station Hammond Bay Road Nanaimo, B.C. V9R 5K6	Graham Gillespie	(250) 756-7215
Inspection Branch		
Shellfish Inspection Specialist 2250 South Burnaby Rd. Burnaby, B.C. V5M 4L9	Klaus Schallie	(604) 666-4427 (ext. 277)
Commercial Licensing		
Commercial Licence Unit 400-555 West Hastings Street Vancouver, B.C. V6B 5G3		(604) 666-0566
Commercial Licence Unit 417 - 2nd Ave. West Prince Rupert, B.C. V8J 1G8		(604) 627-3413
Commercial Licence Unit 60 Front Street Nanaimo, B.C. V9R 5H7		(250) 754-0400

Aboriginal Fisheries Division

South Coast Manager	Rebecca Reid	(250) 756-7296
North Coast Manager	Dale Gueret	(250) 627-3464
Fraser River Manager	Burt Ionson	(604) 666-2032

2. OTHER CONTACTS

British Columbia Ministry of Fisheries (BCMF)

Commercial Fisheries Development Officer PO Box 9359 Stn. Prov. Govt. Victoria, B.C. V8W 9M2	Dave Smith	(250) 356-7642

3. GOALS AND OBJECTIVES

3.1. To ensure a long-term sustainable fishery.

3.2. For data limited fisheries to take a precautionary approach to fisheries management.

3.3. To develop management strategies and fishing plans in consultation with Stock Assessment and clients to provide fishery data to help understand the fishery resources.

3.4. Where fishery data will not meet stock assessment requirements, develop a process with the clients to fund or collaborate in the collection of fishery independent data.

3.5. Develop fishing strategies and management plans where users are accountable for compliance with conservation standards and for meeting harvesting conditions.

3.6. Develop partnerships with users, where the users participate more in the management of the fishery and share the results and costs of the increased involvement.

3.7. Explore opportunities for developing fisheries outside of Canada's Fishery Conservation Zone (FCZ) consistent with Canada's international obligations.

4. HISTORY OF THE FISHERIES

NEON FLYING SQUID

Neon Flying Squid (*Ommastrephes bartrami*) is an oceanic species found world-wide in subtropical and temperate oceanic waters. In the North Pacific Ocean neon flying squid are distributed within thermal boundary zones between warm and cold waters (15^0C to 24^0C), particularly from July to August. Neon flying squid have been the target of the Asian fishery for many years. Historically, it started with the jig fishery operating in small boats around the coastal areas off Japan. The fishery expanded offshore to areas in the North Pacific Ocean using monofilament gillnets, or commonly referred to as driftnets. Between 1978 and 1992 the average annual landings exceeded 200,000 tonnes. After June 30, 1992 an international moratorium (U.N. resolution 44/225) on high seas driftnet fishing was put into effect, which resulted in annual shortfalls of squid on the world markets of approximately 100,000 tonnes.

Driftnets were deemed more effective in catching squid than jigs, however the non-selective nature of driftnets and impacts of the fishery on commercially important fish stocks, marine mammals, reptiles, and seabirds led to research into alternative harvest methods by both the Japanese and the Canadian fishing industries. For example, in 1990 and 1991 a DFO/Japan co-operative venture used commercial Japanese jig vessels to harvest squid inside Canadian waters. The results of these studies have shown that neon flying squid do occur in varying abundance in the Fishery Conservation Zone (FCZ) during summer months and that distribution and abundance is linked to specific ocean temperatures (i.e. 15^0 C and 16^0 C). These experimental fisheries and other studies have also demonstrated a spatial segregation of groups of different sized squid (>35 cm mantle length), mainly females. These larger sized squid occupy areas of the NE Pacific as far north as 50^0 N latitude in the spring and summer and become rare in September. In recognition of this and recent developments in gear technology, opportunities exist for the possible development of a jig fishery for neon flying squid off the west coast of British Columbia during June to September.

In December 1995, Canada and British Columbia signed a Memorandum of Understanding on Fisheries and Seafood Diversification (MOU). The objective of this MOU was to provide an orderly approach to new commercial fishing opportunities in British Columbia. A Federal-Provincial Committee was formed under the auspices of the MOU and developed operational guidelines for the implementation of the three-year pilot fishery for neon flying squid.

In 1996, a total of 53 applications for entry into the exploratory jig fishery for the neon flying squid were received by DFO. These applications were evaluated for eligibility, based on a criteria for entry (Section 6.5.1) established, by the joint DFO/ BCMF Seafood Diversification Committee. Twenty applicants were determined to be eligible to apply for the two licences required for this fishery. These licences are: a licence to fish for experimental, scientific, educational, or public display purposes (under s. 52 of the Fishery (General) Regulations), and a licence to fish or trans-ship fish in waters other than Canadian Fisheries Waters (under s. 68(1) of the Fishery (General) Regulations).

The licences for neon flying squid are non-transferable licences but may be renewed for 1998 under the following conditions: compliance with all conditions of the licence, diligent use is made of the licence, and all required fees are paid.

A precautionary total allowable catch (TAC) of 1,500 metric tonnes (mt) of round weight was established for the 1996 and 1997 fishery. Only seven applicants in 1996 and three applicants in 1997 participated in the fishery. In 1996, six vessels submitted logbooks for a total catch of 4,433 neon flying squid or an estimated total landed weight of 7,434 kg. The reason for the low landings was in part due to the inexperience of the fishers to the new fishing technology, and the possible anomalous ocean conditions off the West Coast of British Columbia during the fishing season. It is interesting to note that the 1996 Canadian albacore tuna fishery, which occurs in the same region as flying squid, was also poor. In 1997, the majority of the fishers were engaged in other fisheries (i.e. large Fraser River sockeye abundance, and other groundfish quotas), hence the low effort and low catch of 1,474 kg. In 1997, two vessels started the season in May. An oceanographic instrument to measure sea temperature and salinity (CTD) was installed on one vessel as part of a ship of opportunity oceanographic sampling program.

The results of the 1996-97 seasons were reviewed by Government and Industry to determine the feasibility of the automated jig fishery, examine the distribution and abundance of this species within and adjacent to the FCZ, assess the effectiveness of the current models of automated jig technology, and collect biological and by-catch information to support sound fisheries management decisions.

A precautionary approach will be continued for the neon flying squid fishery in 1998 and the TAC will remain at 1,500 mt of round weight for this species.

At the end of the 1998 season Government and Industry will review the results of the three-year period (1996-98). The continuation of this fishery will depend on the success of this experimental fishery.

A co-venture with Japanese squid fishing vessels is being investigated for the purpose of transferring fishing technology to the Canadian fishers and further developing the Canadian fishery. Industry will be advised with respect to further development of the proposed co-venture

SCHOOLMASTER GONATE, BOREAL CLUBHOOK, AND BOREOPACIFIC GONATE SQUID

In 1997, three additional species of squid were permitted to be harvested under this fishing plan. These included: schoolmaster gonate squid, boreal clubhook squid, and boreopacific gonate squid. Although these species are known to occur in the FCZ little is known of their distribution and abundance. A precautionary TAC of 75 mt (5% of the neon flying squid TAC) remains in effect for 1998. This will allow fishers additional opportunities to improve their efficiency of the new jig equipment and to learn how to use the new technology for targeting the neon flying squid.

The results of the 1997 season were reviewed by Government and Industry to determine the feasibility of the automated jig fishery for these additional species, examine the distribution and abundance of these species within and adjacent to the FCZ, and collect biological information to support sound fisheries management decisions. Since this is a new fishery, a precautionary approach will continue for the 1998 season.

5. ENFORCEMENT PLAN

The Conservation and Protection Sector of the Department of Fisheries and Oceans has the responsibility to enforce the Fisheries Act and associated regulations, to address conservation, health and safety issues and to maintain proper management and control of the various fisheries.

Users of the resource have a responsibility to report violations. Any suspected or actual fisheries, wildlife or pollution violations can be quickly and discretely reported to the appropriate Enforcement Officer by using the toll free Observe, Record and Report hotline. This toll free number is available 24 hours a day. Confidentiality is assured.

OBSERVE, RECORD AND REPORT - 1-800-465-4DFO (1-800-465-4336)

Enforcement enquiries can also be directed to the local Field Offices during regular office hours.

6. EXPERIMENTAL FISHING PLAN

6.1. MANAGEMENT CHANGES FOR 1998/99

6.1.1. The fishery will open August 1 and close on December 31, 1998 or when the TAC has been achieved.

6.2. Open Times

The fishing period shall begin on August 1 (0001 hr) and end on December 31 (2359 hr), 1998 or when the TAC set for all species for the fishery is reached. All vessels will be required to land all catch within 10 days of the closure.

6.3. Fishing Activities Outside Canadian Waters

The licence holder is only permitted to carry out fishing activities that are in compliance with the applicable regulations of existing international fisheries management and conservation measures for the high seas area.

In order to fish in the waters of any state(s) other than Canada, the licence holder must apply to, and receive from the Department, a licence amendment, and upon application satisfy the Department that all relevant arrangements have been approved by the state(s) concerned.

6.4. Fishing Area

All harvesting shall be conducted in Canadian fisheries waters of the Pacific Ocean, and in waters of any state(s) other than Canada, as described in section 6.3.

6.5. Licensing

Only Canadian registered licensed fishing vessels with schedule II species privileges will be considered for a licence. In order to be eligible for a licence the vessel must also comply with the eligibility criteria listed below, which were established by the joint DFO/BCMF Seafood Diversification Committee for this fishery. Fishers interested in participating in the experimental fishery for neon flying squid and whose vessels comply with the criteria described in section 6.5.1. below are advised to contact the DFO Commercial Licensing Unit for further information.

Experimental Neon Flying Squid licences will not guarantee the licence holder a permanent licence in this fishery. However, their participation will be reviewed and they may be given priority in a more permanent licence system, if one occurs.

6.5.1. Vessel Selection Criteria

6.5.1.1. Licensed to fish in West Coast Canadian waters (i.e., has C licence privileges).

6.5.1.2. Minimum vessel at-sea endurance of two weeks (as measured by the vessel's fuel capacity).

6.5.1.3. A 100 kHz (minimum) echo sounder.

6.5.1.4. Instrumentation for sea surface temperature monitoring and recording.

6.5.1.5. On-board freezing capability to freeze to a core temperature of -5^{0}F within 3 hours with a thermal arrest period of no longer than two hours and a holding capacity of 25,000 pounds.

6.5.1.6. A 50 kilowatt (minimum) generator.

6.5.1.7. Suitable accommodation and workspace for a DFO certified observer.

6.5.1.8. To have installed on the vessel a minimum of four automatic jigging machines (a plan, to scale, of the vessel's deck layout with the jigging machines is required with the application).

6.5.1.9. Vessel and crew must comply with private insurance standards for fishing in these waters.

6.5.2. Licence Category:

The following licences are required to harvest neon flying squid: (1) a licence to fish for experimental, scientific, educational or public display (under s. 52 of the Fishery (General) Regulations). This is a personal, non-transferable licence that must designate the vessel to be used for fishing. The person or company issued this licence will be considered the licence holder of record, and (2) a licence to fish or trans-ship fish in waters other than Canadian Fisheries Waters (under s. 68(1) of the Fishery (General) Regulations). This is a vessel licence, for the same vessel designated by (1). The fee for this offshore licence is $500.00.

6.5.3. Diligent use is made of the licence if 1% of the total aggregate catch, in round weight, of neon flying squid is landed by a vessel prior to the end of the three year pilot period in 1998.

6.5.4. Species:

Neon Flying Squid (*Ommastrephes bartrami*), Schoolmaster gonate squid (*Berryteuthis magister*), Boreal clubhook squid (*Onychoteuthis borealijaponica*), and Boreopacific gonate squid (*Gonatopsis borealis*).

6.5.5. By-Catch Restrictions:

A by-catch allowance of 10 percent of the total catch weight of neon flying squid per trip will be permitted for other squid species, pomfret and blue shark in aggregate. Other species caught must be returned to the water in the best possible condition.

6.5.6. Total Allowable Catch per Year:

The TAC is set at 1,500 mt of round weight of neon flying squid and 75 mt, round weight, for each of; schoolmaster gonate, boreal clubhook squid, and boreopacific gonate squid. The fishery will be closed when the annual quota is reached for all species. Conversion factors will be determined in-season to convert processed squid weights to round weights. This precautionary quota will be reviewed in-season, taking account of available information from the exploratory fishery.

6.5.7. Gear:

The fishery will be conducted using "squid jigs" operated by automated

jigging machines. Each vessel must have installed a minimum of four automated, double spooled jigging machines and may carry a maximum of 20 double spooled machines. In addition, hand jig equipment is allowed as a supplemental gear type to jig machines.

6.6. Notification Prior To Commencing Fishing And Prior To Delivering

(1) Before a Fishing Trip:

The vessel master shall, 24 hours prior to commencing fishing for neon flying squid, personally advise or call by radio or phone Archipelago Marine Research (AMR) at the following number **1-800-663-7152** and advise of the following:

(a) Vessel name and vessel registration number (CFV#);

(b) The location, by latitude and longitude, of the fishing activity;

(c) The anticipated date and time of arrival at the fishing location;

(d) The anticipated date and time that fishing will begin; and

(e) If applicable, a decision to cancel a previous notification of a fishing trip.

(2) Prior to delivering:

The vessel master shall, at least 24 hours prior to delivering his squid catch to a port, advise AMR at **1-800-663-7152** by radio, by phone, or in person of:

(a) Vessel name and vessel registration number (CFV#);

(b) Intention to deliver a load of squid to a landing port or offload to a fish processor/buyer or fish packer;

(c) The name of the port and location therein where the catch shall be offloaded;

(d) The anticipated time of offloading at that place;

(e) The fish processor/buyer that is buying or offloading the catch; and

(f) The method of transporting the catch to a fish processor.

6.7. Validation Of Landings

At the time of offloading the DFO certified Observer shall record the weight of each product type for each species and this weight shall be recorded by the

Observer in a DFO approved validation log. The Neon Flying Squid Validation Log issued by the Eastern Pacific Squid Inc. (Tel: (604) 583-2125, or (604) 925-9648) is approved for both form and content by the DFO Shellfish Data Unit. The DFO Shellfish Data Unit prior to use must approve any alternative to this Validation Log.

6.8. Catch Reporting

6.8.1. Harvest Log Data:

The vessel master is responsible for the provision and maintenance of an accurate record, a "log" of daily harvest operations. This log must be completed and a copy submitted in both hard copy (paper) and electronic form in an approved format as defined by the DFO Shellfish Data Unit, Stock Assessment Division. Logbooks meeting DFO requirements are available from outside service bureau who, for a fee, will provide both logbook and keypunch services, thus complying with the requirement for both a hard (paper) and electronic copy. The original white page copy of the log and the electronic copy must be forwarded, following seven (7) days of each landing, to:

Fisheries and Oceans Canada
Shellfish Data Unit
Pacific Biological Station
Hammond Bay Road
Nanaimo, B.C. V9R 5K6
Tel. (250) 756-7022 or (250) 756-7215
Fax. (250) 756-7138

As an alternative to the above, the vessel master may provide a log in the same form and providing the same particulars as shown in the fishing log sample in Appendix I. The vessel master must also provide an electronic copy which is required to be a true and accurate transcription of the hard copy, delivered on a DOS compatible 3.5" diskette. Diskettes will remain the property of DFO. The electronic copy must be either:

a) An ASCII text file in the data format specified by the DFO Shellfish Data Unit, or

b) The equivalent information in a database table of approved design created by any of the following database management tools: Access, FoxPro, Paradox or dBase.

Contact the DFO Shellfish Data Unit at the above address for information on the acceptable database table design. Both the hard copy and electronic copy must be forwarded at each landing to the above address.

Catch information must be recorded in the harvest log by 1200hrs in the applicable time zone of the day in which a fishing operation was completed. These logs are to be kept aboard the licensed vessel when shellfish are being harvested or when shellfish are on board. Logbooks must be produced for examination by a Fishery Officer or Guardian.

The licence holder of record, recorded with the Commercial Licence Unit, is responsible to ensure that the vessel master has completed and submitted a copy of the logbook data. DFO can only release log data to the reported vessel owner, and only upon written request.

FISHERIES AND OCEANS CANADA WISHES TO REMIND FISHERS THAT IT IS A CONDITION OF LICENCE THAT LOGS BE COMPLETED, TO DFO STANDARDS, DAILY FOR EACH DAY FISHED AND VALIDATED AT THE TIME OF OFFLOADING BY A CERTIFIED DFO OBSERVER. A COPY OF THE LOG AND ELECTRONIC DATA MUST BE FORWARDED TO THE DFO SHELLFISH DATA UNIT IN NANAIMO FOLLOWING SEVEN DAYS OF EACH LANDING. DELAY OF COMPLETION OR SUBMISSION OF LOGS IS A VIOLATION OF A CONDITION OF LICENCE.

6.8.2. Fish Slip Requirements:

It is a condition of this licence that an accurate written report shall be furnished on a fish slip of all shellfish caught under the authority of this licence. A report must be made even if the shellfish landed are used for bait, personal consumption, or otherwise disposed. The written report shall be posted not later than seven (7) days after the offloading and sent to:

Fisheries and Oceans Canada
Catch Statistics Unit
Stn. 416, 555 West Hastings Street
Vancouver, B.C. V6B 5G3
Tel: (604) 666-3784

Fish slip books are available on request at the above address.

7. ON BOARD OBSERVER

When requested by DFO a vessel must carry a DFO certified Observer to collect biological samples and information regarding species composition, size, sex, reproductive state of the target species, and by-catch of non-target species. This is in reference to

subsection 6(2) where vessels are required to carry an Observer, upon request of the Regional Director General, for a specified number of trips. An independent firm will be contracted by industry to provide observer services, which meet DFO requirements. Fishers wishing to use observers from other service agencies must contact DFO to ensure approval.

In lieu of carrying an Observer and subject to the approval of (DFO), the vessel master shall bring either whole squid for sampling or specific biological samples (see section 7.2) to port. The fisher is requested to notify DFO upon return of the sample.

7.1. Duties Of The On Board Observer

7.1.1. At sea detailed monitoring of catch and effort of squid species.

The observer will document detailed information for each fishing operation regarding specific fishing configurations (machine type; lighting arrangement; number, type and spacing of jigs; number, type and spacing of line lights; retrieval rates; etc.), weather and oceanographic conditions, and the catches that these configurations produce. This information is required to develop standardised measures of catch per unit effort (CPUE) to be used in assessment of squid stocks.

Note: A fishing operation is defined as the period when the lines are put into the water to start fishing, at a particular location, to the time when the lines leave the water to stop fishing.

7.1.2. At sea processing conversion factors.

The observer will document yields of specific products (tubes, split mantles, head-and-arms, etc.) from whole fresh squid. These factors are required to convert landings (weights of products) to whole round weight of squid caught.

7.1.3. At sea monitoring and documentation of by-catch.

The observer will be required to provide detailed catch and effort of non-target species (by-catch) and record drop-off rates while fishing for squid species.

7.2. Biological Sampling

Observer(s) will regularly collect biological information from representative samples of the catch. Biological characteristics include dorsal mantle length, whole round weight, sex and sexual maturity. Additional sampling for morphometric relationships (arm and tentacle length relative to dorsal mantle length) and collection of statolith samples for ageing will also be required. This will be used to further our knowledge of the biological characteristics of stocks of squid in the fishing area throughout the season.

8. ATTACHMENTS

Appendix 1a and b. Example of the harvest log for the neon flying squid licence.

FLYING SQUID HARVEST LOG
Vessel Configuration Form

YEAR: _____ VESSEL: _____ SET NO. FROM: _____

CFV: _____ SKIPPER: _____ TO: _____

JIG MACHINES

	Make	Model	Code	No. of Machines	Spools/machine
1.					
2.					
3.					

LIGHTS

	Bulb Wattage	Colour	Type	No. of Bulbs
1.				
2.				
3.				
4.				
5.				
6.				

STANDARD FISHING CONFIGURATION

1. Wheelhouse jig computer? Yes ☐ No ☐
2. Sounder Type: _____ Make: _____ Frequency: _____
3. Satcom Telephone Number: _____
4. Cellular Telephone Number: _____

COMMENTS

Appendix 1a. Example of the harvest log for the neon flying squid licence.

FLYING SQUID HARVEST LOG
Harvest Log

No. 00001

YEAR: _____ VESSEL: _____ SKIPPER: _____

SET NO: _____ BIOLOGICAL SAMPLE TAKEN? YES: ☐ NO: ☐

FISHING OPERATION

	Month	Day	Time (24h)	Latitude (Deg/min)	Longitude (Deg/Min)	Surface Temp (°C)	Moon Phase	% Overcast	Wind Spd (knts)
Start									
Finish									

SET CONFIGURATION

Depth in: Metres ☐ OR Fathoms ☐

	No. of Lines	No. of Jigs/Line	Jig Space (cm)	Haul Rate (cm/s)	Depth Fished Max.	Depth Fished Min.	
1.							
2.							
3.							
4.							

LANDINGS

Weight in: Kilograms ☐ OR Pounds ☐

Squid Species	Code	No.	Weight	Comments
Neon Flying				
School Master Gonate				
Nail				
Eight-arm				
Other Squid:				
1. Opal				
2. _____				
3. _____				

Bycatch Species	Code	No.	Weights	Comments
1. Blue Shark				
2. Pomfret				
3. _____				
4. _____				
5. _____				
6. _____				
7. _____				

COMMENTS

Appendix 1b. Example of the harvest log for the neon flying squid licence.